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PROCEEDINGS

of the Fourteenth Annual

WESTERN FOREST INSECT WORK CONFERENCE

Portland, Oregon

March 4-6, 1963

Not for Publication

(For information of Conference members only.)

Prepared at

Division of Timber Management
Insect and Disease Control Branch
U. S. Forest Service
Pacific Northwest Region
Portland, Oregon

WESTERN FOREST INSECT WORK CONFERENCE, PORTLAND, OREGON
March 4-6, 1963

Row 1 (L. to R.): R. W. Bushing, C. J. DeMars, S. F. Condrashoff, G. Wittig, J. F. Wear, W. L. Baker, K. H. Wright, R. E. Balch, G. R. Struble, P. W. Orr, R. W. Reid, D. O. Scott, J. A. Schenk, R. F. Shepherd, G. Daterman, O. K. Jantz, D. Crosby.

Row 2 (L. to R.): R. A. Werner, W. D. Bedard, H. F. Cerezke, C. B. Williams, R. E. Stevenson, G. R. Hopping, K. Graham, N. D. Wygant, A. A. Berryman, D. L. Dahlsten, P. C. Johnson, D. McComb, D. Dotta, J. A. Rudinsky, W. P. Nagel, D. L. Wood, R. W. Stark, S. Tunnock.

Row 3 (L. to R.): B. M. McGugan, C. E. Brown, R. M. Prentice, R. R. Lejeune, J. R. Dilworth, A. T. Larsen, H. S. Telford, M. M. Ollieu, W. F. Barr, W. D. McClanahan, J. W. Bongberg, C. Sartwell, E. Jessen, C. R. Fink, P. E. Buffam, R. E. Dolph, G. T. Silver.

Row 4 (L. to R.): A. D. Moore, P. G. Lauterbach, V. M. Carolin, C. G. Thompson, P. A. Grossenbach, G. C. Trostle, R. B. Ryan, M. M. Furniss, L. H. McMullen, F. M. Yasinski, H. J. Heikkenen, D. B. Cahill, R. L. Lyon, F. H. Schmidt, W. K. Coulter, N. E. Johnson, J. Capizzi.

Row 5 (L. to R.): D. Schmiege, R. C. Hall, B. H. Wilford, C. A. White, D. R. Lauck, E. D. Pearson, C. L. Massey, D. E. Parker, R. L. Furniss, J. A. Chapman, F. B. Knight, J. M. Kinghorn, A. F. Hedlin, H. J. Hartman, R. G. Mitchell, C. B. Eaton, E. D. A. Dyer, A. E. Landgraf.

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EXECUTIVE COMMITTEE (Fourteenth Conference)

K. H. Wright, Portland	-	Chairman
B. H. Wilford, Fort Collins	-	Immediate Past Chairman
P. W. Orr, Portland	-	Secretary-Treasurer
G. R. Strubble, Berkeley	-	Councilor (1960)
N. E. Johnson, Centralia	-	Councilor (1961)
R. F. Shepherd, Calgary	-	Councilor (1962)

N. E. Johnson, Centralia - Program Chairman

EXECUTIVE COMMITTEE ELECT

K. H. Wright, Portland	-	Chairman
B. H. Wilford, Fort Collins	-	Immediate Past Chairman
P. W. Orr, Portland	-	Secretary-Treasurer
N. E. Johnson, Centralia	-	Councilor (1961)
R. F. Shepherd, Calgary	-	Councilor (1962)
J. A. Schenk, Moscow	-	Councilor (1963)

R. F. Shepherd, Calgary - 1964 Program Chairman

Prepared by the Secretary-Treasurer, P. W. Orr, from summaries submitted by Workshop Leaders. Stenographic services and duplication processing provided by the Insect and Disease Control Branch of the Division of Timber Management, U. S. Forest Service, Pacific Northwest Region.

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FOURTEENTH ANNUAL WESTERN FOREST INSECT WORK CONFERENCE

March 3-6, 1963

The Fourteenth Annual Western Forest Insect Work Conference convened at 9 a.m. in the California Room, Portland Sheraton Hotel.

The Welcoming Address was given by Robert W. Harris, Chief, Division of Station Management, Pacific Northwest Forest and Range Experiment Station, U. S. Forest Service.

Dr. R. E. Balch delivered an outstanding keynote address on "The Future in Forest Entomology."

MINUTES OF THE INITIAL BUSINESS MEETING

March 4, 1963

The Chairman called the meeting to order at 11 a.m. in the California Room, Sheraton Hotel, Portland, Oregon.

The following people from outside the Conference area or those attending the Conference for the first time were introduced:

D. E. Schmiege, Juneau, Alaska
R. A. Werner, Juneau, Alaska
D. R. Lauck, Arcata, California
E. E. Sturgeon, Arcata, Calif.
A. A. Berryman, Berkeley, Calif.
I. S. Otvos, Berkeley, Calif.
C. A. White, Wasco, California
W. L. Baker, Washington, D. C.
J. M. Bongberg, Wash., D. C.
W. D. McClanahan, Wash., D. C.
A. D. Moore, Beltsville, Md.
R. E. Balch, Fredericton, N. B.
Paul Surany, Durham, N. C.
E. W. Clark, Durham, N. C.
R. M. Prentice, Ottawa, Ontario
Gary Daterman, Corvallis, Oregon
O. K. Jantz, Corvallis, Oregon
W. P. Nagel, Corvallis, Oregon
Gertraude Wittig, Corvallis, Ore.
Charles Sartwell, Portland, Ore.
H. J. Heikkenen, Seattle, Wash.

Minutes of the Final Business Meeting of the Thirteenth Annual Western Forest Insect Work Conference at Tucson were approved as printed in the Proceedings.

The Treasurer's report was approved as read. The balance on hand March 4, 1963 was $210.85.

R. L. Furniss's letter to K. H. Wright, informing him that the Entomological Society of America had chosen Portland, Oregon as its 1966 meeting site, was read. Furniss pointed out that the choice was made partly because of the amount of interest shown on the part of forest entomologists in the area. He pointed out that this would be a good opportunity to interest the Entomological Society of America in the work forest entomologists are doing.

The Secretary outlined the recommendations agreed upon at the Executive Committee meeting held on the evening of March 3, 1962. Recommendations arising from this meeting are as follows:

1. That 1963 registration fees be $3.00 regular and complementary for students.

2. That the Nominating Committee, for selection of a councilor to serve for a three-year term on the Executive Committee, consist of R. F. Shepherd, Chairman, assisted by V. M. Carolin and G. C. Trostle.

3. That the 1964 meeting be held in the Calgary-Banff area, the 1965 meeting be held in the Salt Lake City or Fort Collins areas, and the 1966 meeting be held in Victoria, B. C., pending completion of the new forest biology laboratory.

4. That the program theme for the 1964 Work Conference be, "Host Plant--Insect Relationships."

5. That the Western Forest Insect Work Conference Common Names Committee members continue to serve for five years; that the Chairman serve for three years (after having served at least two years as a member); that the Conference make a strong effort to have the Common Names Committee Chairman accepted automatically as a member of the Entomological Society of America's Committee on Common Names; and, that P. C. Johnson explore the best way to accomplish this objective and report to the Executive Committee prior to the 1964 meeting.

6. That the Proceedings be sent to all members of the Western Forest Insect Work Conference each year and that every two years the membership roster be reviewed and brought up-to-date.

7. That the bound survey reports and oral presentation of "Important Insect Conditions" be discontinued. However, rare or unusual insect occurrences should be presented at the Initial Business Meeting.

8. That survey and control groups index only unpublished reports dealing with techniques and new developments, but not those dealing with strictly routine surveys.

9. That the Secretary canvass all participating organizations, requesting them to list their current research projects.

10. That the Secretary dispose of obsolete material in the Western Forest Insect Work Conference files.

Following are the reports of the standing committees:

Common Names Committee

P. C. Johnson, Chairman, reported that on October 16, 1962, eleven common names were proposed to the Entomological Society of America Common Names Committee. Of these, nine were rejected for various reasons but two were approved. The two approved are the Western drywood termite (Kalotermes minor) and the Pacific dampwood termite (Zootermopsis angusticollis).

The annual meeting of the Committee will be held at 8 p.m., March 4, 1963.

R. C. Hall moved the report be accepted as read. P. E. Buffam seconded the motion. Carried.

Education Committee

R. W. Stark, Chairman, reported that the Committee had distributed copies of his paper entitled, "A Forester Looks at Forest Entomology Training," (Jour. For. 1962) to all schools teaching forest entomology courses. To date, the Committee has had eight replies about the paper; all were favorable.

No regular business meeting of the Committee has been scheduled this year. Necessary business will be conducted in Workshop Number 2 of the Conference program.

Unpublished Reports Committee

R. F. Shepherd, Chairman, reported a good year. All participating groups have submitted lists of their current unpublished reports. Three groups have not yet indexed their backlog of reports and two of these do not plan to do so because of the size of the job.

No formal report was filed with the Secretary-Treasurer.

Ethical Practices Committee

G. T. Silver, Chairman, reported the Committee is still functioning. He appointed R. M. Mitchell, R. W. Stark, and J. M. Bongberg (all specialists on ethics) to aid him in nominating a suitable candidate for the office of Chairman in 1964.

The annual business meeting will convene at Broadway and Main, Portland, Oregon at 9 p.m. on March 4, 1963.

Results of the Committee's research will be presented to the Conference general practitioners at the Final Business Meeting, Wednesday.

Kenneth Graham was recognized for his latest contribution to the field of forest entomology--a text entitled, "Concepts in Forest Entomology."

Recommendations of the Executive Committee will be posted during the Conference.

Meeting adjourned 12:05 p.m.

THE FUTURE IN FOREST ENTOMOLOGY - THEME OF THE CONFERENCE

by

R. E. Balch
Canada Department of Forestry
Fredericton, N. B.

I have been asked to say something about "where we should be going in Forest Entomology." It is comforting to know that someone thinks I can still look to the future and say something profitable about it. What I will try to do is examine current trends in our work and suggest the kind of thinking that will help to steer them in the right direction. It will be a somewhat philosophical approach but you will be getting down to the brass tacks in your "workshops."

First, what do we mean by "Forest Entomology?" Strictly speaking, it is the study of forest insects, but your program suggests a broader definition. This group includes men studying a wide range of subjects, as well as men concerned mainly with so-called "control" operations. (I say "so-called" because such operations do not necessarily control insects; they are often designed rather to protect insects.)

What brings us together is a common interest in the prevention of damage to forests by insects. That is our ultimate purpose. Those engaged in research may love their work because it permits them to satisfy that inborn curiosity, which is the essential basis of good research. But we are not employed just to satisfy our curiosity. We owe our good fortune to the fact that insects compete with man for the products of the forest, to which he thinks he has the sole right. But Homo sapiens has come to realize that he can exercise this right only to the degree that he deserved the specific name that he has given himself. (I am not sure whether sapiens is still the accepted scientific name of our species among the anthropologists.)

Perhaps it is just as important to make a real contribution to human knowledge as to preserve the supply of pulpwood for the Chicago Tribune. That is a philosophical question. But the fact is that what each of us is doing must be designed ultimately to contribute to the problem of forest insect control. In that sense we are all economic forest entomologists.

Some of us may be doing basic rather than ad hoc research. But the reason we are doing it is that it has come to be accepted that progress in applied science depends on increasing our knowledge of the fundamental natural forces with which we are dealing.

This necessity of keeping in mind the ultimate practical purpose of our work in no way detracts from its interest. It dictates the kind of

problems we tackle and imposes a degree of discipline that adds to its interest and challenge. I have no patience with the snobbery of the self-titled "pure researcher." Freedom to follow his bent is an important stimulant to the scientific worker, but purity in science derives from soundness of method and honesty of interpretation, not lack of purpose. All good research is pure and all pure research is applicable.

To get back to our definition of Forest Entomology, it seems to cover the whole range of activities that are concerned with preventing damage to forests by insects. It includes research in many fields of biology and also the art of applying current knowledge to current problems.

The Parts

Your program suggests that Forest Entomology is, like Caesar's Gaul, divided into three parts: Surveys and Control, Field Investigations, and Basic Research.

As a subject grows, the more you know about it, the more it tends to become subdivided in this way. It helps you to come to grips with it. Inevitably it gets broken down into compartments and the general practicioner is replaced by specialists.

This process has been going on rather rapidly in recent years. Not long ago there was only a handful of forest entomologists in North America and they covered the whole field. They went from one outbreak to another, identified the pest, studied its life history and habits, observed the nature and extent of damage. They were expected to come up with suggestions for control. This they did by processes of deduction from observation. In the case of introduced species some parasites or predators were imported. In some cases silvicultural methods were suggested, although little was done about them. Some extensive experiments in direct methods were carried out, as by the cutting and barking of bark-beetle trees. In many cases, as a last resort, it was suggested that a stomach or a contact poison would do the trick. Few of these recommendations got beyond the experimental stage and if they did there was little time for study of results. This was the pioneer stage. Some valuable information was obtained and some shrewd guesswork was done but it could hardly be said that the scientific method was being applied seriously to the control of forest insects. We were still exploiting the accumulated natural growth and the practice of forestry was largely an academic subject.

Things have changed, and are changing. It is now recognized, both by Government and Industry, that we must find more efficient methods of growing trees to realize the potential of our forest land. We talk of the forest crop and of "tree farms." Silviculture is catching up with agriculture. As in agriculture this means protection of crops from insect damage.

It has also come to be recognized that this calls for a lot more knowledge than we have--knowledge that can be obtained only by research. And we are beginning to realize that research is a serious matter. It means something more than a few Ph.D.'s in forest entomology, supplied with binocular microscopes, who will come up with quick answers. Forest Entomology is a branch of Applied Biology and we must have the biological knowledge to apply. We will never know all we want to and the control men must work with what we have. But if we are to make any advances, if we are to avoid repeating mistakes, to meet changing conditions--both biological and economic--we must keep adding to our knowledge.

This calls for two kinds of effort: First, rigorous objective study of our empirical control operations--for each is an experiment that can yield valuable information. Second, intensive research into the biological systems and forces with which we are dealing, for on this depends our ability to discover new approaches for further empirical testing.

So we now have a growing number of men working on this subject in different ways, and with greatly improved facilities of staff and equipment. The kingpin, of course, is the forest entomologist proper, the man with a broad knowledge of entomology and forestry who works in the field. His job is to know what goes on in the forest, to assess the importance of insect activity in ecological terms, and determine the nature of each pest problem. He investigates life histories and habits, how they affect the tree and the forest, and the more obvious relationships between insect numbers and environmental factors. He advises the forester regarding the possibilities of control. He also discovers the problems that require more intensive research.

On the one side he has men who are concerned with the carrying out of control operations. To them he must supply the biological information that is needed to enable them to decide what to do, when and how to do it. They include the people responsible for the management and protection of the forest, for the economic and administrative questions involved, as well as experts in techniques such as aerial spraying. The forest entomologist is essentially an ecologist who is expected to know what will happen if nothing is done and, if this is not tolerable, what might be done to prevent it. He should have some idea of the cost but he is not an economist.

On the other side he has a number of colleagues at his service who are engaged in specialized research, with whom he must keep in touch. Their contacts should be reciprocal. In the first place what the specialists are doing is largely the result of his studies in the field--they are trying to answer questions that he has raised. For instance, the entomologist finds high mortality in an insect population from disease. He may go so far as to obtain evidence suggesting it is caused by a virus. But for proof of this he must go to someone who has specialized in the

study of insect viruses. Then he wants to know how it works, if and how it can be used in control. Not long ago there was no one to go to with these questions, but as their importance became evident men have been employed to study them, with valuable results not only in economic entomology but in the whole field of virology.

Or, to take another example, the forest entomologist gathers a good deal of data on mortality factors. He may find some relation between weather and insect numbers, or between parasitism and population trends. He may conclude that this or that factor is of major importance on natural control. But he knows that many interacting factors are involved and only the most intensive, long-term study of these interactions will ever give him the proof he needs. For an understanding of how pest populations may be affected by manipulation of the environment through silviculture or management, by the introduction of enemies or diseases into the complex, or by poisoning a certain percentage of the population--to understand, in other words just what he is doing when he adopts these methods of "control"--he needs to know how insect populations are actually limited or regulated in nature. So there are now a number of men taken from the ranks of the forest entomologists who are specializing in this subject, working out techniques of sampling and study to simplify its complexities so that reliable data can be obtained to test the theories of population dynamics and establish its general principles by scientific rather than sematic methods. To them we must look for guidance in the collection and interpretation of data that will permit accurate assessment of control measures.

I could go on with innumerable examples of the questions that forest entomologists can only answer with the aid of specialized research: In plant physiology, for he often finds that studies of the effects of insects on trees are hampered by ignorance of processes in the healthy tree; in genetics, for he knows that the behavior of populations depends on their genetic constitution, which is by no means static; in biochemistry if he thinks he has a clue that might lead to the synthesis of a selective insecticide; in mycology or microbiology for there are many problems involving the association of insects and microorganisms; or in silvics and silviculture when he wants to know the practicability of creating more resistant forests.

I hardly need to labor the point further that forest entomology, like all other branches of science, is expanding because one question leads to another. As we search for more efficient and more refined methods of control the need for more knowledge, and more exact knowledge, becomes apparent. This leads to increasing dependence on specialists, and on workers in other disciplines.

You have probably noticed that nearly everyone who discusses some trend in applied biology winds up by calling for more research. It be-

comes a bit monotonous and when someone emphasizes what we know rather than what we don't know it can be quite refreshing. But it is a truism that research always opens up new fields of enquiry. This is not a sort of Parkinson's Law that scientists tend to expand their work to occupy the time available. It is the nature of Science.

But we have our immediate, practical problems to deal with on the basis of present knowledge. While the basic research worker dedicates himself to advancing our knowledge, the forest entomologist must apply his results to a better understanding of what goes on in the forest. In turn, he hands this on in the form of recommendations or information to the men responsible for control operations, the specialists in control procedures.

The Whole

The program of this Conference not only reflects the division of workers in forest entomology into groups, but also the desire to prevent this from resulting in watertight compartments. In other words, specialization should not mean fragmentation of the subject; analysis must be followed by synthesis.

The need for integration of effort is always with us and increases with the number of men, and laboratories or agencies involved. We often have many men, and a number of laboratories, working on the same insect, sometimes quite independently. Duplication is inevitable, some of which may be desirable, some a waste of time. Two laboratories in the same Department may be working on the same problem without a clear knowledge of what each is doing, without much attempt to benefit from each others experience, to pool their brains and resources. It is true that we eventually read each others papers, but this is rather a delayed form of contact and no substitute for personal exchange of ideas; for that mutal stimulation that makes the work of two much more than just twice as productive as the work of one.

The difficulty is partly one of geography and organization. Perhaps we need more inter-laboratory teams. I certainly think that we must develop as large units of research as geography permits: Regional laboratories that contain men working in many different but releated fields. Cameron Place has some interesting comments on this in a review of Prof. Platt's book "On Thinking as a Chain Reaction" in the Forestry Chronicle for December 1962. It points out advantages of a large, diverse research group in producing more rapid elimination of bad ideas

and multiplication of good ones. Admittedly, we have to go off into the woods--for many of us that is our laboratory--but we need a good base to return to, with library service, informed colleagues to stimulate or correct our thinking, and access to specialists in other fields. In our case, I think this means laboratories covering the whole field of forest science, preferably located on a university campus.

A point I would like to make here is that when it becomes necessary to integrate all the work on a project, within or between laboratories, I am a firm believer in giving the main responsibility to one man. I have seen too many attempts fail through placing too much reliance on vague arrangements for cooperation and on headless committees.

At the same time, formal organization is no substitute for the desire to work together, which is a prerequisite of any coordinated effort. This is a state of mind that should permeate all our work. The lone worker is becoming an anachronism in Science. This is not an argument for the "organization man," or rigid five-year plans. It is an argument for the free and generous exchange of information, ideas, and criticism, for the synergistic effects of mental contacts which are the life blood of research. Nor is it an argument for uniformity but for constant or periodic attempts to look at our problems from each others viewpoint and discover the basic principles that unite them. When different approaches arrive at different results, it is more profitable to seek the explanation by personal discussion than engage in polemics in the literature.

We see this tendency to emphasize differences, rather than to come together to resolve them, in recent papers on theories of population dynamics. Perhaps competition is the life of Science as well as trade; argument is fun, and can be stimulating. But the function of Science is to test hypotheses rather than argue about them, and to discover principles that bridge the gaps between its different branches.

We have a gap in economic entomology that needs bridging. The literature on insect control might suggest, as it apparently did to Rachel Carson, that there are two kinds of entomologists: Those who believe in chemical control and those who don't. It might give the impression of entomologists as groups of men, armed with scraps of knowledge, galloping off in different directions. This is not true but it is a fact that only in recent years has much been written about the integration of chemical and biological control. The idea has received inadequate attention. We are thinking about it, but there have been few deliberately integrated programs.

This concept of integrated control is of particular importance in forest entomology. The nature of the forest crop prevents us from relying on insecticides and also favors the use of other methods. But when we

do use poisons, we use them in a big way. The development of new insecticides and aerial methods should warn us to study the total effects critically in relation to biological and cultural methods. More than ever we should beware of any disintegration of our efforts in control or research.

It is worth noting that this idea, although not new to us, has recently been given impetus by people outside our profession, with little or no knowledge of our problems, and by books such as "Silent Spring." This biased and emotional attack on pesticides presents a very unflattering image of entomologists that needs correcting, but it should serve to encourage a broader, coordinated approach to research and control. Perhaps we needed this reminder that our problems are ecological, that poisoning insects does not control them in the strict sense of the word. Effective and necessary as it often is in the protection of trees, the chemical method must be used with discretion. Particularly in the case of natural forests--as opposed to nurseries, seed orchards, or plantations--we should look upon it as a stopgap while more permanent, more efficient, methods are discovered or developed.

The Basic Concept

What, then, is the essential basis of our work in forest entomology—the concept that will ensure that our different approaches lead in the same direction and are not at cross-purposes? I see it in the "ecological viewpoint."

This is not a new idea, but it is somewhat abstract and not easily defined. Ecology is the study of relations between organisms and their environment, and with each other. Huxley calls it "scientific natural history" and says it deals with the "dynamic balance of Nature."

I look on it not so much as a branch of biology as a concept unifying all branches--somewhat analogous to the idea of evolution, of which it is a part. When the theory of evolution by natural selection was set forth by Darwin it revolutionized the whole of biology by providing a new approach. I think that we have reached a stage where the ecological idea will have a similarly all-embracing effect which should be particularly evident in such fields of applied biology as forest entomology.

It helps us to understand our problems if we think of the evolution of species in association with each other, rather than separately. The prerequisities of species survival include not only ability to adjust to environmental change but also ability to develop beneficial rather than antagonistic relationships with other plants and animals occupying the same environment. Associations as well as species have evolved, forests as well as trees and insects; and they have evolved in the direction of increasing complexity. This seems to be because complexity increases

stability and stability, or freedom from catastrophic fluctuations in populations is a requirement for survival. In other words, the greater the variety of associated species the more efficient the natural systems that regulate their population density. One of the main objectives in forest entomology is to understand these systems so that we can apply the right correctives when they are not working to our satisfaction--so that we can prevent violent fluctuations. The ecological view of evolution suggests that permanent success in a variable environment may depend on a considerable complex of factors. It at least provides a working hypothesis.

I stress the ecological point of view not as an academic philosophy but as a practical basis for the integration of work in forest entomology. We need a common denominator in our thinking. This lies in recognizing that we are all dealing with some aspect of the ecology of insect populations, and that our results must ultimately be assessed in terms of population dynamics. Whether we are engaged in surveys, control operations, field research, or laboratory research, we are all concerned with populations which have a great capacity for increase that is limited or regulated by a varying complex of interrelated factors. All attempts at applied control of forest insects involve some modification of the natural control complex, by adding new mortality factors or by manipulating the environment to increase the effectiveness of those already present. The question is not so much how many insects we kill but how this affects the whole system. At least this must be the point of view if we are to look beyond the current generation of the pest--beyond the immediate protection of the trees. The necessity for this may not be evident with the annual crops of agriculture but it is ever present in forestry.

This may be an obvious generalization but I think it deserves to be examplified.

Take the spruce budworm. Here is a native insect, with a considerable complex of natural enemies, which periodically becomes so numerous that it consumes all its available food over huge areas. The only method of control being deliberately applied is aerial spraying. It is imperative that we know when and where spraying is necessary; in other words, what will happen if outbreaks are left to run their course. And we want to know what will happen if we protect the trees by killing a certain percentage of the population at a certain time. Will this reduction of population density, accompanied by preservation of the food supply, have desirable or undesirable effects on the mechanisms of natural control?

We cannot answer these very practical questions unless we understand how the mechanisms operate and how density affects them. Serious studies are being made in this direction but they are by no means conclusive. So we make the best guess we can and then assess the results in terms of protection given to the trees and as far as possible in terms of effects on natural factors. The latter is the main concern of the forest ento-

mologist. It is not simple. We must continue to perfect methods of sampling and must not ignore the difficult problem of adequate comparable untreated check areas for comparison.

So far the results of spraying have been satisfactory but we have a long way to go before we solve the budworm problem. Many refinements are needed in the techniques of timing and applying the insecticide. We must minimize the undesirable effects on beneficial insects, wildlife and fish. At the same time, we should continue long-term studies of the population dynmaics of the budworm and associated species at endemic levels before we can say we understand the causes of outbreaks. Is the budworm actually regulated by its natural enemies until a combination of favorable weather and forest type releases it? If so, at what density does regulation break down? Is it possible to prevent this by controlling stand type, or to re-establish the regulatory mechanism by insecticidal methods?

I think the ultimate solution will come from a combination of methods--through "integrated control" based on these studies. The susceptibility and vulnerability of the forest will be decreased by more intensive management--by prompt harvesting at the right age, by reducing the areas of uniform age and composition, and by silvicultural methods of reducing the fir content where this is possible. One effect of this will be to increase dispersal loss which has been shown to be an important mortality factor. Another may be to create a more favorable environment for natural enemies, supporting a larger complex of parasites and predators--not forgetting the birds. This will reduce, though probably not eliminate, the need for insecticides, and they will be applied more effectively as we discover more selective poisons and how to use them so that they will complement natural control. Finally, we should continue to study the possibilities of adding new biotic factors. Intensive research on insect pathogens or parasites may well discover ways of increasing their effectiveness, or using the toxic substances they produce.

The ecological approach aims at establishing general principles in insect control, but the application of these principles will vary with the type of insect. An important type is the "introduced pests." They have one thing in common: They are in a new environment in which the control factors differ from those which have evolved in their native habitat. The most important difference is likely to be a lack of natural enemies adapted to them. So our first thought is to remedy this by introducing parasites and predators.

The European spruce sawfly will illustrate how this approach may be successful, and sufficient. When first discovered in North America, in 1930, it had already seriously defoliated spruce over some 2,000 square miles, but there was no thought of chemical control. For one thing modern techniques had not been developed. As it proved, this was

fortunate; it permitted concentration on biological methods. A large program of parasite introduction was undertaken, involving many species, one of which was reared in tremendous numbers. Meanwhile, sampling methods were developed to study population trends and natural control so that the value of the parasites could be assessed. In brief, this showed that the sawfly was unattacked by native insect parasites or predators; very high percentages of the cocoons were eaten by small mammals, but populations increased until limited by food supply. Several of the introduced parasites multiplied and spread with remarkable rapidity, but before evidence could be obtained that they were capable of reversing this trend a virus disease appeared and the outbreak collapsed. That the disease was responsible was proved by the fact that it alone killed over 99 percent of the larvae.

The collapse of the outbreak was no reason for losing interest in the sawfly--quite the contrary. We had to know what happened at the lower population density, particularly whether the parasites and virus could act as regulating factors. Simplified sampling methods and laboratory rearings, supplemented by extensive data from the Forest Insect Survey, have provided a continuous record for 25 years. This indicates fairly conclusively that populations are now regulated by the combined action of the introduced parasites and the virus. It should be noted that the species of parasites effective at lower density are different from those that were effective during the outbreak.

I have enlarged on this project because I think it illustrates several points of importance.

1. That biological control (by the use of enemies and diseases) can be fully effective. It is particularly appropriate against forest insects and species that are not native. Success will depend, however, on host relationships and the ecology of the agents used. It may often be only partial and have to be combined with silvicultural methods of making the environment more favorable to the process of regulation, or by the use of insecticides. In the latter case, we must find out how to poison the pest and not its enemies.

Such pests as the balsam woolly aphid are more difficult problems. In this case, no parasites or diseases are known. Some improvement has resulted from the introduction of predators but, in general, aphid predators seem to demand a rather high density of their prey before they respond to its increase. And the aphid causes damage at low density.

2. The sawfly project also illustrates the value of a complex of factors. The larger it is the more likely it is to contain the elements necessary to maintain the regulating mechanism as environmental conditions and population density vary.

3. In such complexes specific parasites or predators are often of major importance, but infectious diseases and general predators (including small mammals) may also play an essential role. The function of all these in natural control calls for study. One result of this project was the introduction of a shrew to Newfoundland. Studies being made of this will add to our knowledge of the dynamics of both insect and insectivorous mammal populations.

4. We can also see in this project the value of long-term studies of natural populations. The entomologist who is engaged in biological control is not just introducing parasites and hoping for the best; he is engaged in a scientific experiment in population dynamics. He must develop an experimental design that will give results. The least that can be done is to measure mortalities and population levels over a series of generations and determine their relationship by methods of single-factor analysis as suggested by Morris. But more comprehensive studies will be needed before this method can be considered conclusive.

5. Finally, we have an example of the relationship between field and laboratory work, between the entomologist and the specialist. The virus disease was first discovered through laboratory rearings--before its value was so dramatically demonstrated in the field. At that time there were no insect virologists to go to but Bird, a young entomologist, went to work on the etiology and eventually became one. Methods of propagating the virus were developed and it was possible to use it--to re-distribute it--by purely empirical methods; but without specialized research we would not have known what we were doing. We had to know the nature of the pathogen, its infectivity, how it could be purified, diluted, stored and so on.

This kind of research can then be applied to explain the results of field work. One question that is still not resolved is how the virus maintains itself at low populations. We know that adults can carry the virus, but transmission through the egg does not seem to be the answer. There is reason to suspect that it is carried by parasites. Such questions call for careful research in the field and in the laboratory. One is as basic as the other--I hope no one thinks that research is more basic when it is done in a white coat.

An ecological question that demands this approach is: Why are viruses often lethal in laboratory rearings but ineffective in the field? Working on the winter moth we obtained very interesting virus material from Dr. Kenneth Smith of England. In the laboratory Dr. Neilson has found that it is very lethal to the winter moth, the fall cankerworm, and a number of other Lepidoptera, but so far attempts to introduce it to natural populations have failed.

The work on the sawfly led to the discovery and use of a similar

virus against Neodiprion sertifer, another introduced sawfly. It has also facilitated the recognition of a number of viruses, varying greatly in their host relationships and virulence. It has helped to explain mortality previously classed as "cause unknown."

The possibilities in this field are obvious but they will be realized only through intensive physiological and ecological research. We might remember Bacillus thuriengensis. It was well known for many years before its possibilities as a producer of biological insecticide were realized.

You, as well as I, could give plenty of examples of the interdependence of the forest entomologist in the field and specialists in almost every branch of biology. The closer we look at our problems in the field, the more questions we find for them to answer. And the more a man specializes the more he needs to keep in touch with what goes on in the forest and with the men studying the natural populations to which his work must eventually be applied.

Before dropping this, I would like to give one more example--a common one. We all know the importance of proper identification of species and are constantly referring this problem to taxonomists. Sometimes we are annoyed because they come back with question marks, change names, or want more material. But this only shows they know their business. Species are not dead specimens on pins but groups of living populations, subject to and modified by their environments. Classifications are partly subjective--there are "splitters" and "lumpers." But if they are to be useful, and if the taxonomist is to give us names we can rely on, he needs all the help we can give him--and a fair sample of the population. In fact, it is often the economic entomologist, who, by his close studies of natural populations, provides the solution to a taxonomic question. It is quite usual for such studies to show that what appeared to be one species is really a complex.

What I have been trying to say is that all our work touches on population ecology and this viewpoint should be the connecting link between the groups and specialties into which we are divided. We need to remind ourselves of this whether we are concerned with control or surveys, field or basic research. We are all interested in insect numbers and what determines them.

There is no better term for this than "population dynamics." It is a rather all-embracing term, covering a good deal of disconnected knowledge and a large area of ignorance, which is occupied at present by theory. Our job is to reduce this area and test the theory. This, I think, can be done: (1) By increasing the precision of methods of sampling populations and measuring mortality or reduced fecundity caused by individual factors; and (2) by improving our knowledge of the interactions of these factors. The latter will come only from uninterrupted

studies by competent men who are allowed to specialize in this problem and work with the most suitable species, regardless of their economic importance. By constructing life tables for natural populations, and by experiment, both based on a thorough knowledge of the biology of the species involved, they will clarify the functions of the different types of factors in the mechanisms that regulate or limit populations. This should lead to the simplification of methods by measuring key factors in less intensive but more extensive surveys carried out by the field entomologists in connection with economic problems. The two types of work will dovetail and contribute to the same ends, namely, the forecasting of population trends and the application of the most efficient measures of control.

The complexities of the problem and the disagreements about theory may be confusing, but this is no reason for ignoring it. We might remember the history of the theory of evolution. A hundred years ago the origin of species was a complex puzzle confused by argument. The key to its solution was provided when the theory was developed and supported by the scientific method of collecting and analysing the evidence. It then became a "blinding glimpse of the obvious." Darwin's "law" of natural selection, of the survival of the fittest, clarified the proces and has stood the test of time. But the variety and complexity of the mechanisms involved have provided an inexhaustible field of research.

Similarly, I think that population theory--particularly the idea of density-dependent action--will be fruitful in applied biology. It indicates general principles--"laws" if you wish--underlying the regulation of animal numbers, and the kind of research needed to understand how these operate in any one case.

With this approach forest entomology can make major contributions to understanding of the laws that govern populations in general by studying the factors and mechanisms involved in natural and applied control of specific forest pests. In doing so we cannot ignore the general problem. We can learn from studies of other animal populations. And, as the present furore about insecticides shows, we have to consider the effects of control measures on populations of fish and wildlife as well as insects and trees.

Training Future Workers

As the theme of this Conference is the future of forest entomology, you have logically included in one of your workshops the question of how to train future workers. If what I have been saying has any merit, what light does it throw on the kind of men needed and the kind of preparation they should be given at the universities?

The points I have tried to make are: (1) The inevitable trend toward specialization; (2) the accompanying necessity for integration of all our

work if it is to be applied effectively to forest insect control; and (3) the importance to this of the ecological viewpoint which recognizes that we are dealing with dynamic interrelated populations. Does this mean that universities should be giving more specialized training, or broader training in basic biological principles?

Obviously we need both, but which comes first? We are never through learning; the time spent in university is only the beginning of a life time of study. What can best be learned at this time, and what can best be learned later in the course of our work? The decision has to be made at the undergraduate level.

At present the Professor of Forest Entomology has two functions: The first is to give all students in forestry (I do not include forest engineering, which is a branch of engineering, not forestry) a sufficient understanding of what insects are, and how they affect forests, to enable them to recognize insect problems and approach them intelligently. The second is to discover and train men who will specialize in the study of forest insects.

My own opinion is that both types of student need much the same kind of training and the differences should be more a matter of intensity. Both need a good grounding in the principles of insect control, in ecology and biology. The prime function of a university is to turn out men who can use their heads to solve unforeseen problems, rather than men with heads full of unrelated facts and rules that may become outdated. This applied to the practicing forester as well as the research man, to the silviculturist as well as the entomologist.

If the courses given are to attract good students, they must stimulate their interest and understanding by presenting ideas as well as facts for them to work on. They must emphasize the dynamic aspects of all the biological disciplines, show how they are related, and how each contributes to our understanding of what goes on in Nature.

The special contribution that forest entomology can make to this end is to help students to think in terms of population ecology. This seems to be the best introduction to practical problems, as well as research, and I do not think it can be given too soon. We should begin with general principles, as we know them, and use specific examples to illustrate. As in any other branch of Science, it is as important to realize what we don't know as what we do know, what we need to know, and how such knowledge is obtained, as where we stand at the moment.

To be more specific. It is necessary, for example, to give students some idea of the classification of insects. But this will be misleading if it comes from simple exercises in the use of keys. They will do well enough if they can separate the Orders. What they need to know is the

meaning of the different categories, how the taxonomist works and the kind of material he must have before he can classify variable populations as species.

Also, it is necessary to explain metamorphosis and life histories, but this should not call for memorizing specific life histories. Memory comes from understanding. Examples should be studied chiefly to illustrate the variety of adaptation to the environment--the importance, for instance, of synchronization with the phenology of the host, of diapause in relation to climate, searching ability and dispersal as they influence survival. It is more useful to know that fecundity is related to the hazards of the larval period as determined by the life history than that a certain insect can lay 300 eggs under hypothetical ideal conditions.

When it comes to "control" the emphasis should again be laid on general principles: on the fact that all measures of applied control have to be considered in relation to natural systems, and on the various ways in which these systems may be improved or supplemented. Textbooks that are simply manuals should be used with great discretion. Manuals are fossilized entomology. They may be useful for reference but are bound to be compardiums of over-simplified facts and recommendations, suggesting that forest insect control is a cut-and-dired subject.

In brief, I think that courses in forest entomology will be more useful and stimulating to all forestry students if they cultivate the ability to see the problems of forest insect control from an ecological viewpoint than if they emphasize current techniques. And this will give a common basis of understanding as they diverge later into various fields of work.

I am not arguing for formal courses in ecology. Such courses may have their value, but they tend to encourage the idea that ecology is a separate subject that you can take or leave. To me forest insect ecology is not a branch of forest entomology so much as the whole of it. I prefer to think of the ecological idea permeating all aspects of forest entomology, and providing a link with the other branches of forestry.

I also question the advisability of specialization in forest entomology before the bachelor's degree. Rather it should be taught as an aspect of forest biology, leaving any closer specialization to post-graduate work. More and more we are feeling the need for men who can see our problems whole, who can integrate the results of work in entomology, pathology, and silviculture, who can bridge the gaps between these necessary but somewhat unnatural divisions of forest science. All scientific workers must specialize, they can only be "experts" in narrow fields, but if they specialize too early they will have difficulty in seeing their specialty in proper perspective or communicating with those who should be their colleagues. Results have to be fed back into the

larger body of knowledge before they can be used to solve any ecological problem. The first function of the university training is to develop the necessary broad understanding of forest biology to do this. When the student begins his post-graduate research he can then focus on a very small field without becoming isolated in his thinking, without losing his bearings.

Perhaps this is the way forest entomology is now being taught. It is a long time since I was at college. However, I have enlarged on this subject because some of the graduates and post-graduates coming to our laboratories seem to lack the concept of insects as dynamic populations or of control measures as modifications of natural systems. It develops later from experience instead of providing a framework for their work from the start.

Conclusions

Perhaps I am laboring the obvious; in talking about the necessity of the ecological viewpoint, I am doubtless preaching to the converted. But when we say a thing is obvious, we generally mean it is difficult to prove--or to state clearly. And I think that one of our jobs in Forest Entomology is to clarify the meaning of ecology by integrated, quantitative studies of populations and the functions of environmental factors, natural enemies, and diseases--the part they play in limiting or regulating population density. We must illuminate, not obfuscate the obvious.

I believe that this is the general direction in which we should be going--towards a more precise knowledge of natural systems and how the different approaches to control--silvicultural, biological, and chemical--actually affected them. The first essential is to perfect and simplify our methods of population sampling and analysis.

This, of course, is not all. It is only the framework within which specialized studies of the possibilities of applied controls must fit, so that they can be brought together and make their proper contribution to integrated programs of control. I see the future in these terms:

1. A more general recognition of the necessity of creating a forest environment favorable to natural control--forest stands less susceptible to infestation, or less vulnerable to injury. This is where physiological studies of trees and insects, of host-relationships, will be particularly important, and where the entomologist, silviculturist and practicing forester must work together. This approach is likely to be of most immediate value in the case of that large group of insects that are difficult to classify as primary or secondary pests. Many borers and bark beetles, for instance, attack healthy trees only when they reach a certain population density. The most important element in their natural control

seems to be limitation by the supply of suitable food, a factor that can be manipulated by silvicultural methods. To check this we need more knowledge of their nutritional requirements, and of the physiology of their host trees.

2. We will make more effective use of natural enemies and diseases as we increase our knowledge of their place in control. This will come from more exact studies of introduced species as part of the population dynamics of the host, coupled with more intensive studies of the biology and ecology of the parasites, predators, or microorganisms involved--both in the laboratory and in the field. We need to know more about those charactertistics that determine the effectivenss of parasites and predators: searching ability in relation to the distribution of host or prey, synchronization of life histories, the relative advantages of polyphagous and "specific" enemies. We should examine the evidence regarding the value of large complexes of natural enemies. We will not assess results purely in terms of spectacular effects--so-called "complete control"--but more in terms of their effects over long periods.

Intensive studies of insect pathology are bound to open up new possibilities in the manipulation of microorganisms or their antibiotic products.

3. The ability to forecast outbreaks, and the trend of outbreaks will be improved by basic research and continuous forest insect surveys. Here bioclimatology will play a considerable part. We are past the day when taking meteorological records was a somewhat aimless part of our field studies and resulted chiefly in the accumulation of indigestible data. We must keep in touch with progress in meteorology, with what Wellington calls the "synoptic" method. Climatic factors are the variables in the physical environment that often determine how biotic factors are brought into play and whether or not they can regulate populations below the desired level. They may affect an insect directly, through its natural enemies, or through its host tree. The value of climatic studies will increase with our knowledge of the physiology and ecology of insects and trees, and as they become an integral part of studies in population dynamics.

Annual surveys should be looked upon as research projects which will accumulate reliable data on the abundance and distribution of insects from which we can gradually learn to predict population trends with some degree of confidence. The methods used for making surveys of individual species should be worked out with those engaged in more intensive studies so that each will benefit. The latter are necessarily limited in area and need to be checked by observations over a wide range of conditions. They, in turn, will provide the means with which to interpret the more extensive data of the surveys.

4. Finally, we will most certainly see many improvements in the use of insecticides. More and more they will be looked upon as an emergency measure, a last rather than a first resort, as part of a broader program of control, which may embrace both silvicultural and biological methods.

There may well be an increase in the use of insecticides but it will be an increase in the variety of methods, in the skill with which they are applied, not in the amounts used. We will find more selective poisons, some of which may come from the study of insect pathogens--the biological insecticides. Techniques of application and timing will be improved so that a minimum effective dose can be used. As knowledge of the population dynamics of pests and natural enemies increases, it may be possible to not only avoid adverse effects on parasites and predators but actually to increase their control value.

In conclusion, I might say that looking to the future means thinking in terms of strategy rather than tactics--my excuse for the general nature of these remarks. To summarize my own thoughts: (1) As we look more closely and more critically at our problems, we will see the need for more intensive, specialized research. (2) At the same time, we will also see the need for integrating the planning of research and the application of results--for bringing together larger groups of workers in many fields of forest biology. (3) The basis for this is the ecological viewpoint, which in forest entomology comes to focus in the term "population dynamics."

I make no apology for repeating this term. It is not just a bit of scientific jargon but should be in our every-day vocabulary. In two words it expresses the nature of problems in forest insect control, the aspect of biology with which we are all concerned and to which we can all contribute. It does not imply the acceptance of any particular theory, but indicates our ultimate objective: to understand the natural systems with which we are dealing so that we can modify them effectively, economically, and wisely. And I might add without fear of silent springs.

As forest entomology comes to focus in the study of the dynamics of insect populations, it will find its proper place in the science and practice of forestry. There is a notable trend to the consideration of forests as "ecosystems," rather than vegetative communities, and to study the processes by which solar energy is converted to cellulose. Insects play a part in the ecosystem; they are part of a "food chain" within the system that determines its efficiency in the conversion of energy into merchantable wood, into wildlife, or whatever it is we want. I do not think it is looking far into the future to suggest that this concept will come to be generally accepted in forestry. If so, it will not only guide research into profitable channels but will help to narrow the gaps between different branches of forestry--in particular, between forest entomology and silviculture.

WORKSHOP PRESENTATIONS

Workshop No. 1

WHAT GUIDELINES CAN SURVEY AND CONTROL GROUPS PROVIDE RESEARCHERS?

Chairman: J. W. Bongberg, USFS, Washington, D. C.
Members: J. F. Wear, USFS, PNW For. & Range Expt. Sta., Portland, Oreg.
P. E. Buffam, USFS, PNW Region, Portland, Oreg.
R. M. Prentice, Canada Dept. of Forestry, Ottawa, Ont.
A. E. Landgraf, USFS, RM Region, Denver, Colo.
B. H. Wilford, USFS, RM For. & Range Expt. Sta., Ft. Collins, Colo.
P. G. Lauterbach, Weyerhaeuser Res. Center, Centralia, Wash.

In accordance with pre-arranged plans, and in compliance with prescribed ground rules for handling the workshop, thirty or more members convened on Monday afternoon to develop a set of guidelines survey and control groups should provide researchers, and decide how best to present them to the body of the Conference. The consensus held that the workshop should point up the knotty problems currently encountered by survey and control groups MOST in need of solution, without attempting to outline all of the research that would benefit survey and control operations. Majority opinion also favored a breakdown of the topic into component parts, with brief presentation of each, so as to allow ample time for discussion from the floor. Accordingly, the topic was divided into two parts, namely, (1) surveys, and (2) control. In turn, both were further divided as follows: (a) detection surveys; (b) biological evaluations; (c) chemical control; (d) biological control; (e) silvicultural control; and (f) other control methods. In addition, it was deemed desirable to point up the pressing need for studying the economics of pest control and in evaluating the effectiveness of direct control undertakings. Responsibility for brief presentation of topics was assigned as follows:

Detection Surveys.....John Wear
Biological Evaluation.....Tom Silver
Chemical Control.....Paul Buffam
Biological Control.....Dick Prentice
Silvicultural Control.....Amel Landgraf
"Other" Control.....Bill Wilford
Economics of Pest Control.....Paul Lauterbach
Post-Control Evaluation, and Summary.....Jack Bongberg

Dan Dotta and Galen Trostle volunteered for the job of "recording secretaries." Brief summaries of topic presentations and of discussions from the floor, follow. Insofar as possible, topic presentations included all suggestions offered by the thirty conferees in the workshop.

Detection Surveys.....John Wear

The basic concept of detection surveys by the Federal Governments and their cooperators in Canada and the United States are dissimilar. Accordingly, problems most in need of research attention to improve survey operations in the two countries also are variable. Nonetheless, there are needs to improve detection surveys in both countries, and the following areas of research are offered as guidelines:

1. There is urgent need to determine how best to keep fully abreast of the status of pest populations. Sample plots is one approach; aerial reconnaissance, supplemented by ground checking, is another. Both are used in the United States and Canada. The basic need in both countries is for survey methods to assure discovery of the earliest possible stages of population build-ups. In addition, methods should provide for the orderly accumulation of useful information on pest occurrences, host trees attacked, and the periodicity of population build-up and decline.

2. Research in aerial photo techniques is suggested to improve detection and evaluation survey operations. The usefulness of camouflage detection film for earlier discovery of damage to host trees should be fully explored. There should also be more research devoted to the development of visual aids for aerial observers.

3. Research is needed on methods for delineating outbreaks and in determining degree of stand hazard. Knowledge of stand hazard would materially aid survey operations by guiding survey personnel to high hazard zones in their search for incipient infestations.

4. Improved sampling design, and establishment of confidence levels in sampling are urgently needed for estimating stand depletion resulting from insect attack. Similar studies are needed for sampling pest populations.

5. Research is needed in the correlation of insect populations and observable damage to stands. In addition, there is need for standardization in expressing intensity of stand damage. Aerial observations of damage classes need to be correlated with ground classifications.

6. There is urgent need for the survey entomologist to be equipped with additional tools in his detection tool kit. Sex attractants, and suitable traps, would add measurably to the efficiency and economy of detection surveys. The usefulness of light traps likewise should be fully explored, along with baits or other attractants.

Biological Evaluation.....Tom Silver

An evaluation of the current and potential significance of insect outbreaks is designed primarily to determine whether control is necessary and, if so, whether its undertaking would be biologically sound. Biological evaluation is the most important functional survey operation in Canada and the United States. Because it is, all groups of professional men working on forest problems should assist in providing the information that is needed to analyze all the factors leading to a decision.

There are three main fields where the lack of basic information seriously hampers a penetrating evaluation and where we feel justified in pointing out guidelines to researchers.

1. Life History and Habits -- The survey entomologist must have intimate knowledge of the biology and ecology of all major pest species under endemic and epidemic conditions. Biological information should be related to geography, altitude, stand composition, and weather conditions. Insects behave quite differently in different levels of population density and as to age of the infestation. Information on biology and habits must be known under all conditions. A plea is made to researchers to study the life history and habits of the major species over long periods. The survey entomologist currently is seriously hampered in deciding or advising for or against action to control outbreaks due to the lack of biological information.

2. Effects of Defoliation on Trees and Stands -- A major void in evaluating the significance of an insect infestation is knowledge of the immediate and long-range effects of defoliation on trees and stands. Research is urgently needed on tree susceptibility and stand vulnerability. Until much additional information is developed on both, accurate prognosis of outbreaks will not be possible.

3. Natural Control Factors -- The single and combined role of natural factors that tend to regulate the rise and fall of insect populations is little understood. Research is urgently needed in the field of population dynamics to aid in evaluating the biological significance of outbreaks.

Researchers are urged to pause and review their work at periodic intervals, and if needed, re-orient their efforts so that results can be taken and applied by survey personnel. Oftentimes, small revisions and additions to research projects result in the accumulation of information of extreme value to survey groups for biological evaluations.

Chemical Control.....Paul Buffam

Owners and managers of forest lands rely heavily on insecticides to protect the multiple values of the forest resource against damage and loss caused by insects. Accordingly, there is urgent need to develop and improve chemical control methods. Several areas of research are suggested to aid control groups in combating forest insects.

1. Insecticidal Screening Program -- An insecticidal screening program on a continuing basis is of high priority. The screening program should include a wide range of insecticides directed against all of the most important insects. Screening, of course, should take into account effects on fish, fish food organisms, and wildlife, in cooperation with fish and wildlife agencies and other groups.

2. Field Testing Program -- All of the insecticides that show promise under laboratory conditions should be tested under operating conditions in the field. Field tests of promising new materials, methods and techniques also are of high priority. To the degree possible, all field tests should be conducted in cooperation with fish and wildlife agencies.

The information most needed by control groups from insecticidal screening and testing is as follows:

a. What insecticide is best for use in controlling specific pest species, and what alternative insecticides could be used?

b. What is the correct dosage, and how can it best be applied?

c. What precautions are needed to minimize adverse effects to fish, wildlife and man?

All information on results from field testing should be released to the public so as to prevent distorted opinions of possible harm.

Biological Control.....Dick Prentice

A review of past history of biological control of forest insects in Canada and the United States reveals two major areas where much additional research is needed. First, there is need for a major overhaul in the machinery that has been set up to search for effective biological control agents, and in subsequent propagation and liberation in infested stands. Secondly, much of the material collected and released to date has been done with much too little information on the basis biology of parasites or predators, making it next to impossible to adequately appraise degree of effectiveness. Past records also indicate that propagation and release of large numbers of native parasites and predators are of little

value in improving control of native or introduced species. It would appear that the area warranting major emphasis in future research on biological control is in insect pathology. Survey and control groups thus urge more research in this field, and at many locations in both countries.

The burden of improving on the biological control of forest insects should not be left entirely to researchers. Survey and control groups should assist in every way possible. For example, surveys should be geared for the early detection of introduced pests, and survey groups should develop a sound understanding of the role of natural agents in checking population densities. From that point, however, it is the responsibility of research to evaluate the potential of biological control factors, develop a workable arrangement in international cooperation for the search of potential control agents and, finally, to provide information on the basic biology of these agents so they can be effectively released and subsequently appraised.

Silvicultural Control.....Amel Landgraf

Cultural and silvicultural methods hold great promise as a means of checking losses caused by forest insects. Control groups urgently need new and improved procedures to bolster control programs, and for prevention. Disturbances in forest stands, by man or by nature, often trigger outbreaks. It is thus important to know how to modify management practices to prevent outbreaks, and how best to cope with natural disturbances.

The direct control of bark beetles is extremely costly and effectiveness is usually but temporary. There is major need for research on the role of insects in the ecology of forest stands so as to permit proper practices in management. Much additional research is needed on tree susceptibility and stand vulnerability. Possible use of trap trees to control such major pests as Engelmann spruce beetle, Douglas-fir beetle, Ips and others should be fully explored. Requisites in their use should be prescribed, and practices put to use as soon as possible.

Research should be increased in integrated control, with particular attention to modification of stands during or subsequent to direct control to prevent recurrences of outbreaks. Much is said about intensive management of forest stands, yet little concrete knowledge is available to land managers of practices which will minimize pest problems. Survey and control groups could make rapid strides in reducing losses caused by bark beetles if research could point the way for using improved cultural and silvicultural control methods.

New Control Methods.....Bill Wilford

Many of the methods currently used to control forest insects are outmoded and should give way to modern techniques. However, old methods cannot be abandoned until new ones are developed; thus control groups urge researchers to speed the development of new control concepts. Several guidelines are suggested:

1. Insect repellents -- It would appear that research on materials to repel insects would offer high potential return as a new control technique.

2. Sex attractants -- The possibility of using sex attractants to control insects is not a new innovation. It is a concept, however, which holds much promise and one which is worthy of much research. The recent use of sex attractants, alone or in combination with insecticides, for controlling fruit flies and gypsy moth illustrate the potential value. Control groups urge additional research in this area.

3. Male sterilization -- Use of the sterile male technique to eradicate the screw worm in the South and Southeast stirs the imagination of possible use of this technique for control of forest insects. Many of our important forest defoliators might be brought under complete control by such a method. Furthermore, the method should have widescale application for controlling bark beetles. Despite the hurdles in the mass rearing of forest insects for sterilization studies, the control method holds such great promise that we urge expanded research.

4. Genetics -- We are familiar with recent advancements in breeding trees that are resistant to some tree diseases and to some insects. It would appear that fundamental studies in tree physiology, with emphasis on materials in trees toxic or repelling to their normal complement of pest insects, would eventually lead to indirect control of many of our major pest species. Insect genetics also should receive strong support in research. There are many cases where weak strains of insects might be bred into a normal population, with eventual supplanting of the vigorous strain.

There is no predicting the outcome of fertile minds, and survey and control groups urge researchers to duly consider any and all possibilities in new concepts for controlling forest insects.

Economics of Insect Control.....Paul Lauterbach

Owners and managers of forest lands need guidance and help in determining the cost-benefit relationships in insect control. The total cost of control, including research cost, should not exceed total gain.

Forest disease research has developed guidelines for use in deciding for or against the control of dwarfmistletoes and white pine blister rust. The need is urgent for similar guidelines in insect control. Cooperation with other agencies must be obtained in order to measure the total effect of control projects. This is particularly true in aerial spraying projects because of the real and potential threat posed by spraying to fish and wildlife and public health values.

Landowners and land managers can ill afford to commit large sums of public and private funds for controlling insect outbreaks without knowing that timber products and other useful values saved will equal or exceed the values lost by an uncontrolled epidemic. It is recognized that research on the economics of insect control is not a primary responsibility of forest entomologists. Nevertheless, research in this area is urgent, and we offer it as a guideline to researchers with the suggestion that it be undertaken at an early date.

Summary of Work Shop.....Jack Bongberg

It has been our job to point up to Conference members the types of problems encountered by survey and control groups we believe are most in need of research attention. A brief review of needs as outlined by our workshop would make it appear that survey and control groups are operating without material backing by research to justify procedures. This is obviously not the case, and our presentation merely points to the many problems still in need of solution to permit improvement in operations.

None of the speakers pointed to the void in our knowledge of what happens in stands after outbreaks have been suppressed. There is urgent need for more research in evaluating the effectiveness of control operations. Knowledge of whether control has altered the course of pest populations, the long and short-range effect of suppression, and related information must be developed to aid in evaluating problems in order to permit intelligent decision for or against control action. Our presentation would not be complete without mentioning this pressing problem to researchers.

One final guideline, last but certainly not least, is the need for additional taxonomic research to guide survey groups.

The workshop was then opened for discussion from the floor.

Fred Knight -- More often than not, the public is unwilling to accept information developed by research. Thus, there is need to emphasize the Information and Education aspects of pest control to assure proper understanding of our problems by the public, and of methods used in combating outbreaks.

Don Parker -- It often happens that landowners and land mangers overlook the importance of following precisely the directions prescribed for solution of some problems. Researchers can lead the horse to water, but the horse itself must do the drinking.

Jack Heikkenen -- It is suggested that survey groups strive to make more use of field personnel to assist in the search of forested areas for the early signs of insect infestations.

Dave Crosby -- Many of the prescriptions developed by research groups for remedy to some pest problems are not released in such a way as to be readily understood. Solution may require public information specialists and extension workers.

Val Carolin -- Many of the problems confronting personnel engaged primarily in detection survey operations likely could be overcome by the redesign of detection methods. It is suggested that provision be made in detection surveys for ground sampling on a systematic basis so as to permit an orderly accumulation of information on occurrences of pests. This detection problem, therefore, may not be one in need of research attention, but rather one to be resolved by survey personnel themselves.

Bob Furniss -- The establishment of an insecticidal screening and testing program on a continuing basis has long been pointed up as a pressing need by the Pacific Northwest Forest Pest Action Council. Furniss mentioned that such needs presumably were being met in Canada by the central laboratory directed by Dr. Jim Fettes in Ottawa. He asked for clarification of the point.

Blair McGugan -- The insecticidal screening program underway in Canada is selective and limited. There is need for expansion of the work in cooperation with fish and wildlife agencies. Dr. Fettes relies heavily on results of screening by chemical companies, as well as results from testing at other locations, such as USDA, colleges and universities.

Dave Donley -- It is important to know that an extensive program in insecticidal screening is being done by the Pesticidal Chemicals Division of ARS. This agency could be of material help to forest insect control groups if full use was made of available information.

Ken Wright -- ARS is limited in manpower and funds available for insecticidal screening and Forest Service and others should also begin screening compounds against forest insects. Field testing is also of primary importance in developing insecticidal sprays and both should be included in considering the overall needs in insecticidal programs.

Workshop No. 2

WHAT CHANGES IN ENTOMOLOGY TRAINING ARE NEEDED TO MEET FUTURE DEMANDS?

Chairman: P. C. Johnson, USFS, INT For. & Range Expt. Sta., Missoula, Mont.
Members: W. F. Barr, Univ. of Idaho, Moscow, Ida.
K. Graham, Univ. of British Columbia, Vancouver, B. C.
R. R. Lejeune, Canada Dept. of Forestry, Victoria, B. C.
R. L. Lyon, USFS, PSW For. & Range Expt. Sta., Berkeley, Calif.
R. W. Stark, Univ. of California, Berkeley, Calif.
N. D. Wygant, USFS, RM For. & Range Expt. Sta., Ft. Collins, Colo.
F. M. Yasinski, USFS, SW Region, Albuquerque, N. Mex.

In keeping with the Conference theme, the Workshop initially assumed that the "entomology training" to be discussed was meant to be that needed for a career in some field of forest insect research. As a basis, three fields of research were arbitrarily identified in which most research forest entomologists are to be found:

1. Basic. Studies such as those conducted at the Forestry Sciences Laboratory of the U. S. Forest Service at Corvallis, Oregon; the Forest Entomology Laboratory of the Canada Department of Forestry at Sault Ste. Marie, Ontario and at other forest entomology laboratories of the Department; or at some Canadian and American universities. These are studies dealing with explanations of fundamental life processes in insect genetics, toxicology, physiology, development, and behavior.

2. Applied. Studies comprising the bulk of investigative work in forest entomology at the U. S. Forest Service regional experiment stations, the Canadian forest entomology laboratories, and at some universities and colleges dealing with specific forest insect pests--their biology, ecology, life history, population dynamics, epidemiology, and control.

3. Development and Improvement. Studies to develop techniques for applying research results to improve biological evaluations of forest insect infestations, methods of controlling epidemic insect populations. These are the pilot plant tests or the administrative studies of the pest control branch of the U. S. Forest Service, State or Provincial forestry departments, or of some industrial managers of forest properties.

The initial session of the Workshop on the afternoon of March 4 was largely a probing by the panel and interested Conferees alike to draw out viewpoints, to weight experiences, and to discuss the pros and cons of opinions. The assigned topic was apparently of sufficient interest to prompt continuous and, at times, vigorous, discussion. It is unfortunate that much of it could not have been recorded verbatim. To save the discussion for the record, quoting Dr. D. W. Muelder in the 12th Conference Proceedings, the chairman has taken liberty to record it in three

major categories by means of prepared synopses of individual panel members or of ascribed statements and remarks of the panelists and Conferees based upon his notes or those taken by Mr. Eric Jessen, a student at the University of California. Mr. Jessen's help is gratefully acknowledged.

Research training needs for forest entomologists, as hereinafter presented, are divided according to the viewpoints of three professional groups:

1. Employing agencies
2. Teachers
3. Practicing research entomologists

A. Training Needs From the Employing Agency Viewpoint

Participating panelists: N. D. Wygant, R. R. Lejeune, and F. M. Yasinski.

N. E. Wygant.--The "man-in-the-job" concept guides much of the research programming of the U. S. Forest Service in that it is designed to capitalize on the attributes unique to the available research staffers. The process of training, therefore, appears to be one aimed at bringing out or developing special skills of the individual entomologist. The nature of the skills thus developed often dictates the direction of planned research on specific insect problems.

The same procedures could be used regardless of whether the man is destined for basic or applied research, the two types, for all practical purposes, being inseparable. The importance of having researchers with the necessary scientific know-how to forge ahead on urgent lines of investigation cannot be overemphasized. Recruiting research entomologists, therefore, is a matter of seeking candidates with specific skills or the ability to acquire them.

R. R. Lejeune.--"In Canada the field of activity referred to in the Workshop discussions as basic, applied, or developmental research are conducted under one roof in the forest entomology laboratories of the Department of Forestry. Furthermore, all three are supervised by a single director. Thus the whole spectrum of research and surveys in a region is fairly closely integrated. Officers engaged in "applied" research are expected to conduct studies in depth on the specific problems assigned to them, to learn not only what an organism does, but also how and why it behaves the way it does. Research officers are expected to carry through on their results by collaborating on pilot projects with industry and the Forest Service, and to provide advisory and consultative services as necessary.

We would place much of our survey and control activity under your (American) category of applied research and the same comments with respect to research in depth and consultative and advisory services would apply.

In general, the great majority of our research officer positions call for men with a broad ecological and biological background. In a few specialized fields, such as insect pathology, more specialized undergraduate and postgraduate training may be preferred. Our research officers recruited at the Bachelor's level come mainly from forestry schools, entomology or zoology departments, or from institutions giving undergraduate degrees in general biology. We do not look for a high degree of specialization in recruits trained to the Bachelor's level and we would prefer that whatever specialization is required be taken during their postgraduate training.

The thought was expressed that no matter how specific the assignment, each individual research officer tends somehow to change or modify the job to fit his own talents, background, inclinations, and training and it was felt that considerable leeway should be given to research officers to develop the projects assigned to them. The thought was also expressed that possibly the man was more important than his background or training. A competent individual with the right training is to be preferred, but a competent individual with perhaps not as satisfactory an academic background in terms of types of courses taken should also be capable of turning in a highly satisfactory performance.

In addition to a broadly based ecological and biological background, students so inclined and capable of absorbing the training, would be well advised to take a fair amount of mathematics in their undergraduate courses and, if possible, in their graduate courses as well. Ecological studies are becoming more quantitative and in order to make the best use of the advanced analytical tools being made available by the new computers, a knowledge of mathematical principles is a decided asset."

Recent reorganization of the U. S. Forest Service has put forest entomologists for the first time in the ranks of technicians responsible for the administrations of the Nation's national forests. These are the Pest Control Specialists in the regional offices who must take research results and turn them into operable techniques for insect surveys or control programs.

F. M. Yasinski cited the increased scope and complexity of pest control problems in recent years. Biological evaluations of forest insect infestations demand increasing recognition of biotic factors to adequately assess the importance and trend of the pest populations. Control measures require more and more knowledge of their effect on the pest involved as

well as upon the ecosystems of many types of forests and conditions of management. Surveys and control, together, are competing on ever-increasing terms with the multi-functions of wild-land management.

Because of these things, pest control entomologists are under constant pressure to make avid use of every research result that can be translated into operable survey and control actions. They share with their fellow natural resource managers the frequent dilemma of action programs that need the support of information beyond that which research can provide.

To bridge this information gap and to speed the process of adapting research results to field use, the pest control entomologist finds it necessary at times to conduct pilot plant tests, or administrative studies, which bring together related research findings or extensions of these findings for specific purposes. In these endeavors, they must be guided by the same principles of experimental design, painstaking measurements, and data analyses that govern the work of the research entomologists if their results are to be acceptably significant.

The qualifications of personnel going into pest control work, then, bear some similarity to those preparing for careers in research. In addition, Mr. Yasinski stated that the pest control worker must be an administrator of people, funds, and programs and, by proper communication, to be able to blend his work with that of other forestry objectives. New employees in pest control, he found frequently fall short in their knowledge of statistical methods, insect identification, and oral and written communication.

Further discussion brought out the fact that gradual upgrading of laboratory facilities is making it possible for research agencies to undertake more sophisticated investigations within the abilities of existing staffs or by providing them with minimal in-service training. If the trend toward increasing research facilities continues, however, it is natural to expect that agencies will delve more deeply into more forest insect problems. This, in turn, will inevitably lead to the need for recruiting technicians with a greater degree of skill and specialization.

B. Training Needs From the Teaching Viewpoint

Participating panelists: W. F. Barr, J. R. Wilworth, K. Graham, and R. W. Stark.

This phase of the Workshop elucidated considerable interest because, as was brought out previously, the research entomologist exerts an unmistakable influence in the kind of forest insect research undertaken by reason of his own interest and skills. It follows, then, that quality research must necessarily depend to a considerable extent on searching out men and

women who can be encouraged to acquire the training in technical proficiencies and attitudes needed for successful careers in research.

Much of the discussion centered on (1) the traditional concern over stimulating interest among students for careers in research, (2) the problem of preparatory curriculums for undergraduate and graduate students, (3) the perennial question of how much entomology or how much forestry for a forest entomologist, and (4) the problem of student guidance or counselling. About these things, our Workshop members had these words:

W. F. Barr.--Not wholly convinced that entomologists cannot do a good job in forest insect research without some forestry training. Many problems lie ahead that can be solved by laboratory studies requiring basic biological skills and procedures not necessarily dependent upon the integration of forestry knowledge. Fundamentally, there has been little change in forest insect research objectives except for shifting emphases. The great need is to instill in students the proper attitude and philosophy upon which all good research effort is based. This calls for added attention given to motivating students who may harbor latent research abilities. Coursework alone cannot be relied upon to develop students into effective research workers.

Dr. Barr's remarks stimulated considerable discussion on several points. Most favored a broad, basic education in biological sciences, certain physical sciences, and the humanities for undergraduates, leaving specialization to the graduate level of study. Some contended that a well grounded researcher has a tremendous amount of specialized knowledge to acquire and that the undergraduate level of study is not too early to start acquiring it (Wygant).

One manifestation in the change in research emphasis is a swing to the ecological viewpoint in entomology training (J. A. Schenk); also to more fundamental concepts as exemplified by Dr. Kenneth Graham's new text CONCEPTS IN FOREST ENTOMOLOGY only recently released (Barr).

R. W. Stark.--The following statement is submitted by Dr. Stark covering his presentation and comments:

> "It is recognized that the jobs to do in forest entomology are many and varied and individuals of diverse training and interest are called upon to do research (in its broadest sense--the seeking of answers to problems). In view of this I do not think that we can say anything about training above the baccalaureate level. Such training is dependent upon the trainee, the job he is to do, and the institution he chooses for his training.
>
> "The only comment I would like to make about graduate training is the lamentable attitude on the part of many employers, private, state forest service, and Federal Forest Service on several counts:

(1) Many employers feel that graduate training is superfluous, that the man with a baccalaureate degree can learn "on the job." In rare instances and for certain functions this is true, but for the majority of forest insect positions, whether in seeking fundamental causes of insect outbreaks or trying to find a control method for a specific insect, this is not true.

(2) In this connection, employers generally do not pay enough attention to the undergraduate training received by individuals hired to do work in which forest entomology plays a part and this includes all forestry jobs as well as more restricted forest entomology studies. It seems obvious to me that a forester who graduates from an institution without having taken forest entomology and pathology is inadequate to handle problems which he will have to face. This view is shared by the forestry profession as evidenced by the Education Committee report of 1962. Also, a biologist from entomology or zoology or other specialized field with no forestry background is inadequate to deal with forest insect problems as he has no appreciation of the complexities of forest synecology.

Such inadequacies are fostered by hiring agencies because most apparently do not recognize any differences. For example, it is my understanding that employers generally pay no attention to S.A.F. accreditation; nor do they distinguish between those school which do not recognize their own B. S. as a professional degree and those which give a B. Sc. F. or professional degree.

(3) Many employers (and universities too, for that matter) have downgraded the Master's degree to the point where it is looked upon as a degree given to those who could not make the Ph.D. The Ph.D. seems to be the union card to so-called "basic" research and acceptance as a professional scientist. The Master's degree should be recognized on a merit and incentive basis for what it is: Advanced scientific or professional training, but not to the supposed depth of the Ph.D. I think if we took a searching look at many of our Ph.D. degrees granted today they might be recognized as closer to the Masters level.

Prostitution of the Masters degree is aided and abetted by those schools which give a non-professional B. S. and a Masters ticket for one additional year's work.

"The area in which I think this workshop can make the greatest contribution to actual training is at the undegraduate level. As has been pointed out, forest entomologists may come from almost any background--principally forestry, entomology or other biological fields. The two basic requirements of a forest entomologist are that he is adequately trained in forestry and in entomology. As pointed out above, however, we now have many specialists working on problems involving forest insects, but these cannot be called forest entomologists in the usual sense.

"We must recognize that it is rare that anyone can achieve this dual specialty at the undergraduate level regardless of his background. Because forestry, and even botany, are often not considered essential to the training of an entomologist or a zoologist, I choose to ignore consideration of their training at the undergraduate level--people of such background <u>have</u> to take graduate training.

"I would like to save the rest of my comments specifically for the undergraduate forestry training. It is from this source that we draw most, if not all, of our professional forestry people and many of our forest entomologists and <u>forest entomology is an integral part of forestry training.</u> Whether a forester becomes a forest entomologist or not, no matter what phase of the forestry profession he enters, he is continually faced with insect problems just as he is faced with disease, fire and wildlife problems.

"This fact is recognized by the profession itself. (As determined from questionnaires sent in 1958 by the Education Committee, Western Forest Insect Work Conference, to 880 practicing foresters holding membership in the Society of American Foresters and the Canadian Institute of Foresters, results of which are presented here by Dr. Stark in tables 1 and 2 from his published report: Foresters look at forest entomological training. Jour. Forest. 60(2):132-134. 1962 Ed.)

"Table 1.--Questions asked and responses of those foresters who have not taken forest entomology.

Questions	Yes	No
1. If you were advising a student enrolled in forestry, and forest entomology is an elective course, would you advise him to take it?	88	5
2. Do you feel that not having had the course has made you less effective as a practicing forester?	60	30
3. Have you ever had to deal with any aspect, from detection to control, of a forest insect problem?	88	5
4. Do you feel confident that you have a reasonable grasp of real or potential insect problems in your lands?	65	26

Questions	Highly	Moderately	Not Very
5. If you were to hire a forester to work in the field under your responsibility, how desirable would you consider his having had a course in forest entomology?	37	50	6

"Table 2.--Questions asked and responses of those foresters who have taken forest entomology.

Questions	Yes	No
1. Have you ever used this training in your professional work?	360	48
2. If not, is this because:		
(a) You have not encountered the problem?	37	9
(b) The training was inadequate?	23	8
3. If you were again an undergraduate would you, based on your professional experience, elect a course in forest entomology?	391	15

"Also, Samuel T. Dana in his book on Forestry Education based on a long-term study by the S.A.F., places "Forest Protection" which includes insects, disease, fire and wildlife as a "core requirement" in any forestry curriculum. Presumably this also reflects the philosophy of the Society of American Foresters.

"It is of greater importance now than ever, in the light of the present outcry on pesticides which could lead to restrictive legislation hampering forest protection efforts, that the forester, at whom the finger of guilt is so often pointed, be educated with respect to the hazards of using methods not clearly understood. He should also be made aware of the other methods of protection available, other than use of pesticides.

"Although many, perhaps the majority, of schools of forestry do recognize these facts and present curricula which are in line with Dana's recommendations there are many which do not.

"In my opinion, it is the responsibility of the employers, the educators, and of working forester, including forest entomologists to bring to the attention of degree-granting institutions these factors. It is recognized that there are many problems involved in establishing a curriculm which give the embryonic forester a "well-rounded basic training" but it seems to be well established that forest entomology is one element of the training which cannot be ignored, or even put on an "elective basis."

Following are some of the comments in the discussion following Dr. Stark's presentation:

...Agreed generally with Dr. Stark's statement, but felt that forestry schools need to be convinced of the value of increased coursework in entomology for undergraduate students.. It is hard to conceive of a man trained broadly, a narrower training might be more suitable for some students. Education for research is not all coursework, but much depends upon other methods of developing research abilities of students most of whom vary greatly in this respect. Can't overemphasize the importance of instilling research attitudes for those students who profess an interest in this field. Our aim is to turn out good researchers, not necessarily subject specialists. Finally, those entering a career in research must do so with a full understanding that they are embarking on a lifelong task of continued learning (Barr).

...Entomologists with no background in forestry can do research on some phases of forest entomology, but they cannot always relate their findings to natural conditions they might obtain under forest environments (Stark).

...Disagreed that forestry schools are not cognizant of the need for forest entomology coursework for undergraduate students. Cited the University of Idaho where certain forestry students in their junior year can be relieved of some forestry-required courses to take selected electives, including entomology. Such students receive a baccalaureate that is not accredited by the Society of American Foresters which serves as a good starting point for graduate study (Schenk).

...The Conference got nowhere in past years in requesting added courses in forest entomology for forestry school requirements (Barr).

...Continued, forceful action may bring this needed adjustment. The University of California once required forest entomology and forest pathology for forestry students, but this has since been changed. There is a real problem in establishing forestry curriculums at UC because of the high ratio of junior college transfers and the emphasis on forest economics. The University is aiming to establish a non-professional baccalaureate in forestry which would be accredited by the S.A.F. (Stark).

...Many prospective researchers are being overlooked among forestry undergraduates because they receive no stimulus or indoctrination on the values of research as a possible career (Wygant).

K. Graham.--Agreed with most of what has been said. Research in forest entomology is being done today by men who come from a wide variety of educational backgrounds:

1. Those holding only degrees in forestry.

2. Those with entomology degrees and acquired coursework and/or degrees in forestry.

3. Those with entomology acquired as part of zoology curriculums.

4. Those having had forestry, botany, and/or zoology for the first three years then switched to entomology for the fourth year to graduate in this discipline.

Students switching majors, particularly from non-biological to biological, or from botanical to zoological courses, often can overcome curriculum deficiencies with little extra time lost. They often profit from their more diversified background.

In commenting on the above, Dr. Rudinsky noted that the current trend in requirements for degrees in entomology is to reduce the scope of the subject matter and to teach more of the principles rather than the particulars. Requirements are severely restricted by the 4- or even 5-year undergraduate curriculums of American universities. In Europe, six years are required for a degree in entomology with two semesters devoted to forest entomology.

Students beginning graduate work in forest entomology, he continued, do not pose the problem that those with B. S. degrees in entomology do, inasmuch as the latter faces at least 45 hours of coursework in forestry, more than that required for prerequisites in entomology. He suggested the desirability of plant physiology and silviculture for forest entomology majors and agreed on the previously expressed need for more personalized research training as is done in Europe.

Dr. J. R. Dilworth sat patiently through parts of the Workshop dealing rather critically with the apparent lack of integration of certain biological sciences with forestry curriculums. Needless to say, his remarks came as a sparkling revelation of the dramatic changes that have recently been made in some forestry curriculums.

J. R. Dilworth.--The following summarizes recent changes in the forestry curriculum at Oregon State University:

> "As I indicated in my presentation, the School of Forestry recognizes that the responsibilities of the forester are changing rapidly. There is hardly a place in the profession any more for the pure forester who is a complete generalist without some area of specialization. We do, however, feel that the basic core of the general forestry program is a good starting point for a foundation on which to build curricula that meets the needs of the profession. Our new Forest Science Option is designed to train the student as a forester, but permit adequate opportunity for specialization in such fields as forest entomology, pathology, genetics, or other areas of science. Actually, we are attempting to prepare these young men to go on in graduate work in the areas of their special interest. We do not feel our program is a terminal program."

Continuing, Dr. Dilworth stated that forestry, like forest entomology, was undergoing tremenduous change in application and, to a matching extent, in the need for new training. It is no longer possible for graduates to rely on career possibilities requiring broad, generalized training in forestry. Moreover, changes in the profession are manifesting themselves in increasing form and frequency, forcing those charged with developing forestry curricula to forecast at least 10 years in advance.

Changes approved in the OSU forestry curriculum this past year reflect an outstanding need for foresters with added scientific training.

The University's new Forest Science Option rests, in part, on the premise that the freshman student in forestry often lacks a clear-cut objective insofar as career possibilities are concerned or, similarly, the curricula that might best encourage his own subject interest or develop any incipient aptitudes. The Option, furthermore, attempts to meet already recognized needs of the profession and the prospective employer as well as the student. It offers an undergraduate program that gives forestry students (1) a well-grounded basis for proceeding into graduate study in any one of a number of forest sciences and (2) an opportunity to develop early in their academic career the attitudes, interests, and prerequisite proficiencies necessary for successful careers in research.

Through drastic revision of the undergraduate curriculum, the Forest Sciences Option provides for a B. S. degree in Forestry with the following requirements:

1. 37 hours of forestry courses that will meet accreditation standards of the S.A.F. and U. S. Civil Service Commission for forestry option.

2. 74 hours of science courses.

3. 36 hours of electives, including one year of foreign language.

4. 26 hours of liberal arts courses.

5. 31 hours in miscellaneous courses.

The curriculum for the new option is made up of (1) a freshman year common to all forestry programs, (2) a sophomore year under the Forest Management program with minor exceptions, and (3) curricula during the junior and senior years especially adopted for the new option as follows:

Oregon State University
School of Forestry

Curricula in Forestry
B.S., B.F., M.S., M.F., Ph. D. Degrees
Forest Engineering Forest Management Forest Products

Freshman Year[1]
Common to all programs

	Hours
Botany (Bot 201,202)	6
Mathematics (Mth 101, 102, 200)	12
Chemistry (Chem 101, 102, 103 or Chem 201, 202, 203)	9
English Composition (Wr 111, 112, 113)	9
Engineering Graphics (GE 115)	3
General Forestry (F 111)	3
Forest Engineering (FE 123)	3
Forest Orientation (F 40)[2]	0
Physical Education, General Hygiene	3
Electives	3
	51

1/ Remedial courses in mathematics preceding the college courses will be required unless the student demonstrates ability to undertake college-level work. All students receiving credit for the English sequence who fail to pass a comprehensive examination given upon completion of the sequence will be required to take additional English courses.

2/ Noncredit course required of all freshmen.

FOREST MANAGEMENT

Sophomore Year

	Hours
Dendrology (F 254)	4
Mensuration (F 224)	5
Forest Protection (F231)[1/]	3
Forest Engineering (FE 223)	4
Wood Technology (FP 210)	3
Extempore Speaking (Sp 111)	3
Principles of Economics (Ec 201, 202)	6
Forest Soils (Sls 214)	4
Basic Geology (G 210)	3
Plant Physiology[2/]	3-5
Technical Report Writing (Wr 227)	3
Physical Education	3
Elective	5-7
	50-51

1/ Forest Science option requires Bot 415 and Ent 321 in lieu of F 231. Substitutions optional for others.

2/ Forest Science option requires Bot 331, 5 hours.

FOREST MANAGEMENT
Accredited Society of American Foresters
Forest Science Option

Sophomore Year--Same as Forest Management program (With minor changes as noted)

Junior Year

	Hours
Forest Ecology (F 341)	4
Silvicultural Practices (F 342)	4
Forestation (F 343)	3
Forest Valuation (F 324)	3
General Physics (Ph 201, 202, 203)	12
American Governments (PS 201)	3
Humanities or Social Science Electives	9
Approved Science Electives	4
Electives	9
	51

Senior Year

Seminar (F 407)	1
Forest Economics (F 412)	3
Forest Administration (F 415)	3
Forest Management (F 425)	5
Statistics	3
Foreign Language Sequence	12
Approved Science Electives	15
Electives	9
	51

C. Training Needs From the Practicing Research Entomologist's Viewpoint

Participating panelist: R. L. Lyon.

What does the forest entomologist already engaged in research think should be done to improve training for a career in this field? Dr. Lyon's comments are based on his own educational achievements (Ph. D. degree in Entomology, U. of California, 1961) and his experience of 10 years in the Forest Service on forest insect research.

R. L. Lyon.--"I decided to present my contribution to the Workshop as a series of questions. The order has no special meaning.

1. Should we concentrate on developing scientists (in the best sense of the word; e.g., capable researchers, inventive, creative, original thinkers, etc.) in entomology or concentrate on developing various specialists? Should entomologists be scientists first and specialists second, or vice versa? Is it not true that to develop a scientist is the more elusive goal, and will not the development of specialists take care of itself (there is a strong tendency to specialize)?

2. If we emphasize the development of scientists in entomology, what are those most important qualities of a capable scientist and how do we encourage their development?

3. Will progress in entomology be aided by diverse educational backgrounds?

4. Should we welcome entomologists turned forest entomologists and foresters turned forest entomologists equally or should we place a premium on the one or the other? What are our criteria?

5. How far should we go in setting up training guidelines that circumscribe "ideal" backgrounds should we find it desirable or even possible to settle on them?

6. Can we mistrain when we set up arbitrary standards that we think will develop experimentalists capable of solving our problems as we conceive them now and run the risk of training tomorrow's entomologist to solve yesterday's problems?

7. Are biological problems becoming more and more in need of quantification (measuring instead of classifying)? How does this affect educational needs?

8. How much attention should be given to education after employment? What forms should this take?

9. Should we be thinking in terms of developing the highest potential in the student (focus on the student), or more in terms of the problems that need solution and the training needed to mold specialists to solve these problems (focus on the problem)? Can we see potentials in students? Can we encourage them?

10. How much freedom should we allow the student in planning his own education? How differently would we handle this for undergraduates and graduates? Should we encourage the student to develop along the lines natural to him, wherever that may lead, in contrast to holding him to an established curriculum? Are we encouraging, thereby, the talent of following a well planned pathway, whereas the scientist has no pathway to follow but must cut his own in uncharted areas? Must we be careful not to dampen unnecessarily the natural enthusiasm of the student by a burdensome, relatively inflexible curriculum? Can we allow more freedom in the course of study by crossing college lines freely? Do we risk losing much good potential talent that cannot flower under a more or less rigid educational system? How can we adjust the "system" to top this potential?

11. Should we incorporate enough flexibility into our educational system so that the student may specialize to any extent as early as he wishes or may study as broadly as he wishes without restraint? Or should some limits be set, some restraint in the course of study be required? What criteria should we use to judge this?

"I also mentioned certain areas of study that I felt would have better prepared me for research had they been given more emphasis:

1. Philosphy and history of science.

2. General scientific method, tactics, and strategy (includes use of apparatus).

3. Communication (all forms, including library use).

4. Basic subject matter; e.g., zoology, biology, ecology, biophysics, biochemistry, and biomathematics.

5. Training in field and laboratory situations.

6. Exposure to going research (federal, state, and private) in the form of visits and active participation (e.g., without pay and for college credit)."

Dr. Lyon's comments, particularly points raised in his question number 10, evoked further discussion of this viewpoint. Faculty members at the Workshop generally favored some measure of control over the student's graduate training by means of curriculum requirements and the fullest

possible counselling. However, most recognized the delicate balance needed to provide the student with a certain amount of systematized coursework and yet develop his instinct toward self development of special skills and interests.

Summary

From the able presentation of the Workshop members and the spontaneous discussion between the members and the attending Conferees, the Chairman ventures to summarize the proceedings thusly:

1. There is no magic formula or prescribed procedure for training prospective researchers in forest entomology.

2. A good researcher is largely the product of his individual initiative, "divine curiosity" (Balch), independent and creative thinking, and self development nourished by the tools of learning--encouragement and guidance of a respected and sympathetic faculty or research administrator, facilities to undertake and evaluate experimentation, and realization of the desperate need for research results.

3. A discernible trend is gaining momentum toward somewhat drastic revision of undergraduate curriculums to:

   a. Arouse the desire of students for careers in research.

   b. Stimulate interest in allied disciplines.

   c. Provide a better base for graduate studies for those striving for careers in research.

4. Research agencies are increasing their facilities for more sophisticated investigation with these results:

   a. Stepped-up in-service training for present research staffs.

   b. More intensive search for recruits with known research potentialities whether of a general nature or in given specialties.

   c. Close liaison between agencies and academic institutions to provide for inter-communication on research programs, changing employment opportunities, and training needs.

5. Present curriculums appear to be adequate for research training in forest entomology if fully availed, particularly at the graduate level, but they are not necessarily adequate on any one campus.

6. The environment for doing research in off-campus agencies is improving in in-service training, technical and library facilities, some aspects of research administration, and in the awareness of research benefits by the general public and by legislative bodies, endowment foundations, and others responsible for disbursing research funds.

Workshop No. 3

WHAT GUIDELINES CAN FIELD ENTOMOLOGISTS GIVE BASIC RESEARCHERS?

Chairman: J. M. Kinghorn, Canada Dept. of Forestry, Victoria, B. C.
Members: D. Crosby, USFS, Alaska Region, Juneau, Alas.
A. F. Hedlin, Canada Dept. of Forestry, Victoria, B. C.
R. G. Mitchell, USFS, PNW For. & Range Expt. Sta., Portland, Ore.
R. W. Reid, Canada Dept. of Forestry, Calgary, Alta.
M. M. Furniss, USFS, INT. For. & Range Expt. Sta., Boise, Ida.
G. R. Struble, USFS, PSW For. & Range Expt. Sta., Berkeley, Calif.
K. H. Wright, USFS, PNW For. & Range Expt. Sta., Portland, Ore.
C. Sartwell, USFS, PNW For. & Range Expt. Sta., Portland, Ore.
G. R. Hopping, Canada Dept. of Forestry, Calgary, Alta.
R. A. Werner, USFS, Northern For. Expt. Sta., Juneau, Alas.
S. F. Condrashoff, Canada Dept. of Forestry, Calgary, Alta.
C. J. Demars, Univ. of California, Berkeley, Calif.
E. D. A. Dyer, Canada Dept. of Forestry, Victoria, B. C.
R. E. Balch, Canada Dept. of Forestry, Fredericton, N. B.
D. O. Scott, USFS, Northern Region, Missoula, Mont.

Summary of the Workshop Discussion Presented by the Chairman on Wednesday, March 6

Congratulations are due the Executive and particularly the Program Committees for incorporating the workshop concept into this Conference. The 16 persons that met in this workshop formed an optimum-sized group. The setting provided ample opportunity for all to express their thoughts in an atmosphere unstifled by formality. The method stimulated a much higher rate of personal exchange than would be expected in a larger meeting where most come just to listen.

The whole of the period on Monday afternoon was devoted to the assigned topic. The initial period was spent in defining who and what we were intending to discuss. After a rambling but interesting and profitable flow of ideas, the group set about summarizing its findings for presentation. Interpretation of the majority opinion on most issues was left to the Chairman and recorders.

In defining who we were discussing, we recognized the undesirability of overlapping the topic of the first workshop which was discussing the guidance that control and survey workers might give researchers. The "field entomologist" was defined as a general practitioner investigating specific and economic insect problems with understanding of the insect and practical solution as prime objectives. It was recognized that the "field" entomologist was too loose a definition for our discussion because basic researchers can, and often do engage in field work, and

conversely the general forest entomologist often has to take his work to the laboratory. Basic researchers were defined as specialists such as taxonomists, insect pathologists, geneticists, etc., whose prime objectives are to develop principles and techniques in the field of general entomology and in specialized disciplines pertinent to forest insects.

In defining what we were discussing it was agreed that "guidance" meant more than merely pointing out to specialists the needs and unknowns in forest insect work. The broader interpretation of "guidance" was adopted which laid the basis for discussing ways and means whereby the one group can help the other - or how mutual benefit between general practitioner and specialist can be derived.

Primarily, good communication between research groups is the foundation upon which guidance and cooperative work is built. Communications between generalists and specialists may take diverse routes such as through scientific literature, conferences, field trips, and personal correspondence. The majority felt, however, that the greatest benefit for both groups is achieved through personal contact. Where possible, general practitioners and specialists should be housed together where day-to-day contact permits mutual appreciation and understanding of each others problems and capabilities. In most instances, it is not possible for many specialists and general practitioners to be brought together into a common working environment. Therefore, responsibility rests with the general practitioner for maintaining an up-to-date knowledge of the whereabouts, capabilities, and personalities of the specialists whose work may impinge on the field of forest entomology.

In the course of his work the general practitioner encounters almost daily unknowns that will ultimately require the attention of one or more specialists for solution. It can be useless and demoralizing for the G.P. to shower the specialist with seemingly endless lists of unknowns. The specialist is only too keenly aware of the paucity of our knowledge of the biological intricacies that surround us. The type of guidance the specialist can use and which the general practitioner can provide, is the fund of knowledge the G.P. has already accumulated on a specific problem. With the background provided by the G.P., the specialist is in a realistic position to judge whether or not his particular capabilities can contribute toward a solution. Before proposing work for the specialist, the G.P. should have explored the problem sufficiently so that he will be able to ask intelligent questions of the specialist, to know how a particular specialist can help towards a solution, and to recognize lines of work that will be profitable for the specialist. The G.P. should be familar with the problem to have developed his own hypothesis in order that he can stimulate, rather than attempt to direct the work of the specialist.

As a rule, the G.P. will seek the aid of specialists when he reaches the point where his equipment, or training, or terms of reference permit him to go no farther.

It was also recognized that G.P.'s can also provide guidance for specialists without having attained an advanced level of knowledge of a problem. The G.P. can bring to the attention of specialists undiagnosed ills of forests that would otherwise remain unknown to specialists, or in the course of his duties, the generalist may by chance stumble on leads that suggest profitable avenues of work for specialists.

Messrs. Hopping, Hedlin, Struble, and Crosby presented examples of several ways by which the general worker can, and have provided guidance for specialists. Mr. Hoppings' example cited a case whereby he, as the generalist, had explored to his limit certain taxonomic subtleties of the genus Ips, but with this foreknowledge he was able to provide a cytogeneticist with a fruitful line of work that benefited both. Mr. Hedlin described some of his work with seed and cone insects which indicated the need for specialists to throw light on extended diapause. His example emphasized the need for exploratory work by the G.P. in order to intelligently enlist the aid of appropriate specialists. His example indicated the need for help of a plant physiologist, an insect physiologist and a bioclimatologist. Mr. Struble related the example of a problem recognized but undiagnosed by the forest entomologist. In this particular instance Monterey pine in one locality was suffering dieback that could not be attributed to insect damage. In this way the generalist, by detecting and recognizing an unusual biological situation was able to record, for the benefit of one or more specialists, a significant biological event that might have otherwise gone unnoticed. Finally Mr. Crosby described a situation whereby a chance opportunity for testing certain insecticide formulations provided leads which a specialist, such as a toxicologist, might follow.

In summary, one can confidently state that members of this workshop concurred with the thought that it is not adequate to merely categorize and list for specialists the myriad of unknowns that confront general workers. It seems obvious that much work remains to be done at all levels of forest insect research. Instead, we wish to stress that personal contact, communication, and mutual stimulation amongst persons engaged at all investigative levels, will provide the most profitable and satisfactory atmosphere of work for all concerned.

Workshop No. 4

WHAT GUIDELINES CAN BASIC RESEARCHERS GIVE FIELD ENTOMOLOGISTS?

Chairman: C. G. Thompson, USFS, PNW For. & Range Expt. Sta., Corvallis, Ore.
Members: D. R. Lauck, Humboldt State College, Arcata, Calif.
G. Wittig, USFS, PNW For. & Range Expt. Sta., Corvallis, Ore.
C. A. White, Bioferm Corporation, Wasco, Calif.
V. M. Carolin, USFS, PNW For. & Range Expt. Sta., Portland, Ore.
D. E. Schmiege, Northern For. Expt. Sta., Juneau, Alas.
A. D. Moore, USFS, Agric. Research Center, Beltsville, Md.
L. H. McMullen, Canada Dept. of Forestry, Victoria, B. C.
F. B. Knight, Univ. of Michigan, Ann Arbor, Mich.
R. B. Ryan, USFS, PNW For. & Range Expt. Sta., Corvallis, Ore.
N. E. Johnson, Weyerhaeuser Research Center, Centralia, Wash.
F. H. Schmidt, USFS, PNW For. & Range Expt. Sta., Corvallis, Ore.
P. Surany, USFS, SE For. Expt. Sta., Durham, N. C.
C. B. Williams, USFS, PNW For. & Range Expt. Sta., Corvallis, Ore.

In theory, forest entomology can be divided into three steps or categories: (1) "basic" research, (2) "applied" research, and (3) control and survey. The pioneer forest entomologist performed all three steps. In more recent times, increase in knowledge has resulted in the need for specialization, so "Research"and "Control" were separated with specific assignments and responsibilities. We now appear to be entering a phase in which a division is taking place within "Research." For want of better terms, we may call the divisions "Basic" and "Applied." It is difficult to make a sharp distinction between these categories since one leads gradually into the next. Many entomologists, therefore, may perform research of both types. For the purpose of this discussion, however, the categories are treated as distinct entities.

The primary function of "basic research" is the development of basic principles, methods and techniques which the applied researcher can use as "tools." Anything which detracts the basic researcher from his major function lessens the contribution he makes. In reality, however, the basic researcher, because of his specialization, is often the only one qualified to perform certain services which are essential to the applied researcher. In such cases, the basic researcher has an obligation to provide these services to the extent to which they are reasonable and feasible. This service should be considered to be a duty and not a favor. This is a two-way street--the applied researcher may furnish aid and services to the basic researcher, e.g. in the conduct of a field study. In some cases, however, it may be necessary to draw some limit to the amount of service that can be performed by either side.

With these considerations in mind, this workshop proposes the following guidelines to the field entomologists:

1. Services. In requesting a service, the applied researcher should consider and indicate: (1) the need for the service and (2) the urgency with which the finished service is required. The workers furnishing the services should, on their own initiative, provide applied workers with suggested procedures.

2. Communication. The committee has agreed that we should make basic information more readily available before publication as this may involve a delay of a year or more. Perhaps the inclusion of problem-oriented free-discussion meetings involving relatively small but actively interested groups could be considered for some of our work conferences.

3. Training. Basic workers should encourage development of applied use of their specialities and of "basic" studies by workers in the field. On-the-job training at the basic labs should be available to interested and competent field workers. Field workers should never be allowed to develop the idea that "basic" research is the exclusive property of the basic laboratories.

Workshop No. 5

WHAT ARE THE GREATEST NEEDS IN FOREST ENTOMOLOGY FOR THE IMMEDIATE FUTURE?

Chairman: C. B. Eaton, USFS, PSW For. & Range Expt. Sta., Berkeley, Calif.
Members: W. D. Bedard, USFS, PSW For. & Range Expt. Sta., Berkeley, Calif.
J. A. Chapman, Canada Dept. of Forestry, Victoria, B. C.
R. L. Furniss, USFS, PNW For. & Range Expt. Sta., Portland, Ore.
H. J. Heikkenen, Univ. of Washington, Seattle, Wash.
C. L. Massey, USFS, RM For. & Range Expt. Sta., Albuquerque, N. M.
B. M. McGugan, Canada Dept. of Forestry, Ottawa, Ont.
D. E. Parker, USFS, INT For. & Range Expt. Sta., Ogden, Ut.
R. F. Shepherd, Canada Dept. of Forestry, Calgary, Alta.
D. L. Wood, Univ. of California, Berkeley, Calif.

Workshop 5 was held March 4, from 2-5 p.m. in the Sheraton Hotel, Portland, Oregon. All panel members were present, together with about an equal number of conferees assigned to the workshop. Each panel member gave a synopsis of his ideas about immediate needs in forest entomology. Thereafter, the conferees attending gave their views. The panel then attempted to sort out and group suggestions that had something in common, and establish their relative priority.

Generally speaking, the kinds of needs that came to light during the discussions fell into one of the following three categories: services, communications, and analyses.

Needs for the following types of services were suggested: taxonomy, translations, tracer laboratory facilities, data processing, literature location and retrieval, and a directory of forest entomologists. Discussion developed the fact that strengthening taxonomic work in the U. S. was one of the most urgent needs in this category. This need is recognized by the entomology profession and by the major agencies responsible for such work. The workshop agreed that a directory of forest entomologists would be useful, and subsequently recommended to the Work Conference the establishment of a committee to explore the possibilities of developing such a directory. The workshop concluded that the other four types of services were needed to a lesser degree, and that efforts to meet these needs probably could be expected to proceed on an agency basis.

The proposals advanced for strengthening communications included: a forest entomology journal, a North American congress of forest entomology, cooperation in world forest entomology through such agencies as I.U.F.R.O. and the North American Forestry Commission F.A.O., and better communication with users of research results through such devices as industry short courses, etc. On the subject of publications, the workshop concluded that existing outlets were ample, and that a separate journal for

forest entomology was not warranted now, although it might be justified in the future. Likewise, the need for a congress composed of representatives of various work conferences, and meeting at 3-5 year intervals, was not favored on the grounds that it would tend to isolate forest entomologists. Discussion of communicating research results to users indicated that extension units at the federal and state levels provide adequate machinery and generally do the job in the U. S. The consensus was that in Canada more effort is needed to integrate the results of forest insect research with forestry practice.

The workshop reviewed two recent developments that provide additional machinery and increased opportunity for forest entomologists to communicate on a world-wide basis. These are the formation of a Working Group on Forest Insects and Diseases by the North American Forestry Commission F.A.O. and the establishment of a committee for International Cooperation in Forest Insect Research by the I.U.F.R.O. It was brought out that these committees provide a convenient means: (1) for forest entomologists in different parts of the world to become acquainted so that they know who to turn to about a foreign pest problem; (2) for bringing together standardizing and disseminating what is known about insect pests; and (3) for preparing uniform quarantines and paving the way for regulatory programs when a destructive insect moves from one part of the world to another. At the suggestion of the workshop, this subject was later presented in some detail to the Conference as a whole for the information of the conferees.

The principal suggestion in the third category was that the Work Conference sponsor an analyses of forest entomology research needs on a west-wide basis. The purpose would be to help define the status of knowledge in this field, show where future effort should be directed, and provide a basis for setting priorities. Discussion developed the fact that at state and federal levels certain steps along this line already have been taken. The workshop concluded that the accomplishment of such an analysis by the Conference would be difficult if not impossible because of the size of the job. Consequently, whatever is done along these lines was left to be done on an organization basis.

The workshop identified three important general needs which forest entomology has in common with many other lines of research, namely: able scientists, research support, and program continuity.

The workshop chairman Eaton, assisted by panel members Furniss, Heikkenen, McGugan, Shepherd, and Wood, gave a summary report of the workshop at the concluding session of the Work Conference on March 6.

MINUTES OF THE FINAL BUSINESS MEETING

March 6, 1963

The Chairman called the meeting to order at 3:10 p.m. in the California-Oregon Room, Sheraton Hotel, Portland, Oregon.

The Chairman acknowledged the fine program that N. E. Johnson had arranged.

Minutes of the Initial Business Meeting were read. R. R. Lejeune moved adoption. Seconded by G. R. Struble. Carried.

Dr. J. A. Schenk was nominated as Councilor for a three-year term, ending 1966. N. E. Johnson moved nomination be closed. Seconded by P. E. Buffam. Elected by acclamation.

R. C. Hall moved acceptance of Calgary-Banff as the 1964 meeting site. P. E. Buffam seconded. Carried.

A. E. Landgraf suggested that the Denver-Fort Collins areas be considered for the 1965 meeting site. This was followed by the pros and cons of these areas.

D. E. Parker suggested that Salt Lake City also be considered for the 1965 meeting.

C. L. Massey moved that a choice be made between Denver-Fort Collins and Salt Lake City for the 1965 meeting site. Seconded by G. C. Trostle.

The matter was submitted to a show-of-hands vote which showed 32 in favor of Denver-Fort Collins and 24 in favor of Salt Lake City. Denver-Fort Collins is the 1965 meeting site.

G. C. Trostle suggested the possibility of holding a joint meeting with the Lake States and Southern States Forest Insect Work Conferences in 1965. The Chairman asked A. E. Landgraf to explore the possibilities and report to the Executive Committee prior to the 1964 meeting.

R. W. Stark moved that the theme for the 1964 Western Forest Insect Work Conference be "Host Plant--Insect Relationships." Seconded by R. E. Stevenson. Carried.

R. F. Shepherd was appointed Program Chairman for the 1964 Conference.

In discussion that followed, David McComb favored allowing at least part of one day for discussion of control and survey activities. R. R. Lejeune questioned that there was enough known about the 1964 program theme to carry the Conference for three days. The Chairman pointed out that the Program Chairman should have enough latitude to fill in with some of the subjects recommended in the Executive Committee Minutes. N. E. Johnson and Kenneth Graham suggested that a tree physiologist and pathologist might be asked to participate.

R. C. Hall moved that bound copies of "Important Forest Insect Outbreaks in Western North America" be prepared for each Work Conference up to, and including, the 19th annual meeting (1968). D. D. Dotta seconded. Carried.

T. W. Koerber moved that oral presentation of insect conditions be discontinued at future meetings. Seconded by R. R. Lejeune. Carried.

Standing committee reports are as follows:

Common Names Committee

Chairman P. C. Johnson read a formal report of Committee activities. Six of the nine common names rejected by the Entomological Society of America will be resubmitted for reconsideration.

The Committee's formal report is appended to these Proceedings.

J. M. Bongberg stated that it would be desirable for all common names committees to work together in presenting common names of forest insects to the Entomological Society of America's Committee on Common Names. By so doing, forest entomologists would present a common front and not merely represent sectional views.

C. B. Eaton proposed that the Western Forest Insect Work Conference canvass other Insect Work Conferences' Common Names Committees and urge joint action in having forest entomologists represented on the Entomological Society of America's Common Names Committee. The Conference Chairman and P. C. Johnson will investigate this proposal and report to the Executive Committee prior to the 1964 meeting.

P. C. Johnson and others felt that insect common names approved by the Work Conference should be used even though they were rejected by the Entomological Society of America.

D. L. Wood was appointed to fill a vacancy on the Common Names Committee.

Recommendations arising from the Executive Committee meeting were accepted by the Work Conference as follows:

1. That the Common Names Committee members continue to serve five-year terms.

2. That the Chairman serve for three years after having served two years as a Committee member.

Education Committee

No formal report.

Indexing Unpublished Reports Committee

No formal report.

Ethical Practices Committee

The Chairman, G. T. Silver, reported that few individuals met the high standards formerly used in the selection of candidates. Rather than lower the standards, the group felt that G. T. Silver should continue at the helm for another year.

R. L. Furniss moved that the Western Forest Insect Work Conference send an expression of appreciation to Dr. R. E. Balch for presenting his paper at the meeting. Seconded by N. E. Johnson. So ordered.

R. L. Furniss moved that the Western Forest Insect Work Conference members urge publication of Dr. R. E. Balch's paper in the Journal of Forestry. Seconded by A. E. Landgraf. Carried.

H. J. Heikkenen stated that a national or international specialist on insect-host relationships should be invited to participate in the 1964 Conference. K. H. Wright asked the new Program Chairman to investigate the proposal.

H. J. Heikkenen moved that a committee be appointed to study the problems that would be involved in compiling a directory of forest entomologists, countrywide. Seconded by N. E. Johnson. K. H. Wright appointed H. J. Heikkenen Chairman. He is to select two members to aid him in this project.

C. B. Eaton announced that the Pacific Branch of the Entomological Society of America will meet at Gearhart, Oregon in June 1963.

R. L. Furniss announced that the Index of Economic Entomology has been discontinued. He asked for a show of interest. The majority of the group favored continuing the Index. Furniss stated that there appeared to be favorable interest countrywide but little monetary support.

Meeting adjourned at 4:45 p.m.

APPENDIX

COMMON NAMES COMMITTEE REPORT

The annual meeting, held March 4, was called to order by the Chairman at 8:15 p.m. at the Sheraton-Portland Hotel. Committee members present were Messrs. Brown, Carolin, N. Johnson, P. Johnson, and Struble. One visitor was present, Mr. David Lauck, Humboldt State College, Arcata, California.

The scheduled replacement of Committee members adopted by the Conference in Tucson March 13, 1962 was discussed. At the request of the Conference Chairman, the incumbent Committee Chairman agreed to accept a further three-year appointment as Chairman to coincide with his three-year election to the Committee on Common Names of the Entomological Society of America.

A motion by N. Johnson, seconded by Carolin, was unanimously passed naming termination dates for incumbent Committee members. The following dates were agreed upon:

Conference year	CNC member to be replaced
14th (1963)	Denton, Missoula
15th (1964)	N. Johnson, Centralia Carolin, Portland
16th (1965)	Brown, Calgary
17th (1966)	P. Johnson, Missoula Struble, Berkeley
18th (1967)	Evans, Victoria

Possible replacements for incumbent CNC members were discussed, the consensus being that a list should be maintained as an aid to the Conference Chairman in his appointments to the Committee. The following Conference members were suggested:

W. F. Barr	Moscow, Ida.	R. G. Mitchell	Portland, Ore.
S. Condrashoff	Vernon, B. C.	W. P. Nagel	Corvallis, Ore.
M. M. Furniss	Moscow, Ida.	D. A. Ross	Vernon, B. C.
K. Graham	Vancouver, B. C.	J. A. Schenk	Moscow, Ida.
A. F. Hedlin	Victoria, B. C.	R. W. Stark	Berkeley, Calif.
H. J. Heikkenen	Seattle, Wash.	B. E. Wickman	Berkeley, Calif.
T. W. Koerber	Berkeley, Calif.		

Following considerable discussion on the recent action of the ESA Common Names Committee in rejecting 9 of the 11 common names proposed by the WFIWC Common Names Committee, Carolin moved (Struble seconded) (motion passed) that some of the rejected name proposals be resubmitted to the ESA Committee with more complete justification statements and that, further, certain Committee members be assigned the task of preparing statements for specific insects, as follows:

Barbara colfaxiana	Douglas-fir cone moth	N. Johnson
Zelleria haimbachi	Pine needle-sheath miner	Carolin
Ergates spiculatus	Giant softwood borer	P. Johnson
Pseudohylesinus grandis	Silver fir beetle	Coulter
Pseudohylesinus granulatus	Fir root beetle	Coulter
Platypus wilsoni	Wilson ambrosia beetle	N. Johnson

New justification statements for the above are to be sent to the Conference CNC Chairman by June 1.

A motion by Carolin (N. Johnson seconded) (motion passed), the CNC proposal form for common names is to be modified as follows:

1. Increase space allotments for paragraphs 14 and 15 a.

2. Delete Part B. This section will be maintained as a separate form for use of the CNC Chairman.

It was agreed that Conference members should be reminded to submit any proposals for common names by or at the next meeting. The Committee will continue to submit names to the ESA Committee despite the low ratio of acceptance.

Action taken by the Conference Executive Committee at its meeting in Portland on March 3 includes the following:

> "Common Names Committee.--In view of Phil Johnson's appointment in December 1962 to the Common Names Committee of the Entomological Society of America, he has agreed to continue his present chairmanship of the WFIWC's Common Names Committee for another three years. His tour of office as Chairman of our Committee was to terminate at this meeting. The Executive Committee recommends:
>
> A. That WFIWC Common Names Committee members continue to serve for five years.
>
> B. That the Chairman of the Committee serve for three years (after serving at least two years as a member).

C. That the Conference make a strong effort to have the Common Names Committee Chairman accepted automatically as a member of the ESA Common Names Committee.

D. That Phil Johnson be asked to explore during the coming year the best way to accomplish this objective and to report his findings to the Chairman of the WFIWC prior to the 1964 meeting."

The meeting was adjourned at 9:30 p.m.

COMMITTEE MEMBERSHIP

Common Names Committee

P. C. Johnson, Chairman

C. E. Brown

V. M. Carolin

R. E. Denton

D. Evans

N. E. Johnson

G. R. Struble

D. L. Wood

Education Committee

R. W. Stark, Chairman

K. Graham

R. C. Hall

J. A. Rudinsky

S. M. Sturgeon

H. S. Telford

J. P. Vité

F. C. Werner

Unpublished Reports Committee

R. F. Shepherd, Chairman

Ethical Practices Committee

G. T. Silver, Chairman (still)

MEMBERSHIP ROSTER

WESTERN FOREST INSECT WORK CONFERENCE

Note: Active members registered at the Conference in Portland, Oregon, March 4-6, 1963, are indicated by an asterisk(*).

USFS REGION 1 (Missoula) and REGION 4 (Ogden)

*BARR, Dr. W. F.
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COX, ROYCE E.
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DAVIS, Dr. DONALD A.
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REGIONS 1 and 4 Continued

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